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The Scottish Government
Riaghaltas na h-Alba
defra Department for Environment Food and Rural Affairs

Accessing and developing the required biophysical datasets and data layers for Marine Protected Areas network planning and wider marine spatial planning purposes

Report No 22 Task 3 Development of a Sensitivity Matrix (pressures-MCZ/MPA features)

Final

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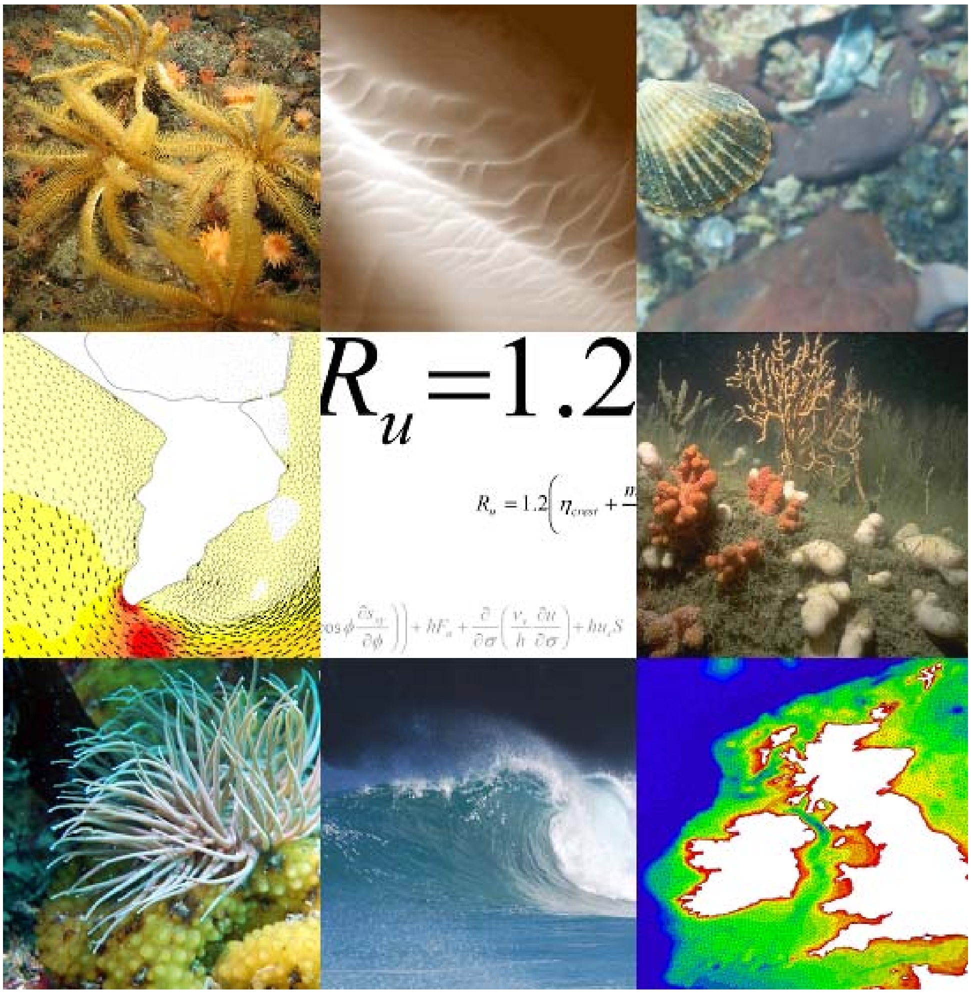

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NATURAL ENVIRONMENT RESEARCH COUNCIL
PRIFYSGOL BANGOR UNIVERSITY
ABP mer marine environmental research
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exeGesIS Spatial Data Management

Project Title: Accessing and developing the required biophysical datasets and data layers for Marine Protected Areas network planning and wider marine spatial planning purposes

Report No 22: Task 3. Development of a Sensitivity Matrix (pressures-MCZ/MPA features)

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Executive Summary

Introduction

The UK is committed to the establishment of a network of marine protected areas (MPAs) to help conserve marine ecosystems and marine biodiversity. MPAs can be a valuable tool to protect species and habitats and can also be used to aid implementation of the ecosystem approach to management, which aims to maintain the 'goods and services' produced by the healthy functioning of the marine ecosystem that are relied on by humans.

A consortium[1] led by ABPmer have been commissioned (Contract Reference: MB0102) to develop a series of biophysical data layers to aid the selection of Marine Conservation Zones (MCZs) in England and Wales under the Marine and Coastal Access Act 2009 and the equivalent MPA measures in Scotland. Such data layers would also be of use in taking forward marine planning in UK waters. The overall aim of the project is to ensure that the best available information is used for the selection of MPAs in UK waters, and that these data layers can be easily accessed and utilised by those who would have responsibility for selecting sites.

The Marine and Coastal Access Act allows for the designation of MCZs for geological and geomorphological features and species and habitats of conservation interest. To deliver this requirement, the project has been divided into a number of discrete tasks, one of which was to review the current approaches used to assess sensitivity of habitats and species to human pressures. In November 2009 it was agreed not to progress with the development of either a sensitivity or vulnerability data layer under that contract but instead to focus the work on delivering a sensitivity and pressures matrix for individual features. This report details the work carried out to fulfil this remit.

Objectives

The three objectives for the study have been as follows:

- To develop methods for developing a matrix describing the sensitivity of features to pressures through a workshop based approach for EUNIS Level 3 broad-scale habitats, OSPAR threatened and/or declining habitats and species and the UK BAP habitats and species listed in Annex A.
- Achieve consensus through a workshop approach to the sensitivity scores for marine features and pressures.
- To produce a technical report describing the method used for developing the sensitivity/pressures matrix, and a confidence assessment for each benchmark.

It is intended that the users of this output will be the Statutory Nature Conservation Bodies (SNCBs), Defra, Scottish Government, the Welsh Assembly Government and the regional MCZ projects in taking forward the designation of Marine Conservation Zones or Scottish nature conservation MPAs. It also intended that the table may

[1] ABPmer, MarLIN, Cefas, EMU Limited, Proudman Oceanographic Laboratory (POL) and Bangor University.

have longer term application for use by Government Departments, and may be further built on in the future.

Methodology

The pressures-features sensitivity matrix was developed in three stages. In the first stage, a draft methodology and pressure benchmarks were developed and the sensitivity matrix was block-filled with existing assessments where relevant. The draft methodology and pressure benchmarks were reviewed by the Project Steering Group and Science Advisory Panel.

In the second stage, two expert workshops were convened to undertake sensitivity assessments to complete the population of the matrix and to provide feedback on the application of the methodology and pressure benchmarks. The first workshop was held in Peterborough on 8/9th July, and was attended by statutory nature conservation body (SNCB) staff and experts in the marine ecology of features. The second workshop was held in London on 28/29th July, attended by experts from industry. A further small workshop was held in Plymouth on 31st July for marine ecology experts that were not able to attend the Peterborough workshop.

In the third stage, the information from the workshops was reviewed and collated and remaining gaps were completed by the project team to provide a draft final matrix. This matrix was circulated to the Project Steering Group and Science Advisory Panel for review and comment prior to its finalization. A draft report was also prepared describing the background to the study, the methodology and key findings. This was also circulated to the Project Steering Group and Science Advisory Panel prior to its finalization.

Defining Pressure Benchmarks

An initial list of 39 pressures in 7 broad categories was provided to the contractors, based on a review of existing pressure assessment frameworks undertaken by JNCC. To support the sensitivity assessment, one of the pressure categories was subsequently divided into 2 sub-categories to provide a total of 40 pressure categories for assessment.

Initial pressure benchmarks were developed for the identified pressures drawing on a range of sources:

- existing benchmarks from other sensitivity assessments (MarLIN website);
- environmental quality standards (for example, water quality standards established under the EC Water Framework Directive (2000/60/EC);
- guideline values for concentrations of contaminants in sediment and biota (e.g. OSPAR environmental Assessment Criteria (EAC's), Canadian Interim Sediment Quality Guidelines (ISQGs);
- initial thresholds developed for indicators of Good Environmental Status under the EC Marine Strategy Framework Directive (2008/56/EC) (Cardoso *et al*, 2010);
- climate change projections (UKCP09);
- expert knowledge of the nature and scale of hydrological changes associated with marine infrastructure developments in UK waters;

The initial draft benchmarks were reviewed by the Project Steering Group (PSG) and the Science Advisory Panel (SAP). Testing and further review of the benchmarks was undertaken through the workshops. Experience with the application of the benchmarks at the workshops led to changes in the descriptions for a number of the benchmarks.

Some of the pressures (introduction of other substances, introduction of light, visual disturbance, litter, electromagnetic changes) were identified as not being specifically relevant to MCZ features and were therefore not assessed in this study.

Sensitivity Assessment Methodology

The sensitivity assessment methodology has been adapted from a number of approaches (based on the review of approaches, undertaken by ABPmer in 2009), and in particular Hollings (1978); MarLIN (Hiscock & Tyler-Walters 2006; Tyler-Walters *et al*. 2009); OSPAR Texel-Faial Criteria (OSPAR 2003); the CCW 'Beaumaris approach' (Hall *et al*., 2008); Robinson *et al*. (2008) and the Review of Marine Nature Conservation (Laffoley *et al*., 2000). The draft methodology was reviewed by the Project Steering Group and Science Advisory Panel.

The approach considers the resistance (tolerance) and resilience (recovery) of a feature to assess sensitivity to pressures. The final sensitivity assessment methodology was developed to address the requirement to make rapid assessments using an expert-based approach and that could be applied at a range of feature scales - species, habitat, broadscale habitat level.

The sensitivity assessments involved the following stages:

A Definition of the key elements of the feature
B Assessment of the feature resistance (tolerance) to a defined intensity of pressure (the benchmark intensity);
C Assessment of the resilience (recovery) of the feature; and
D The combination of resistance and resilience to derive an overall sensitivity rank.

Confidence scores were also assigned to the individual pressure-feature sensitivity assessments based on the quality of evidence that was available to support the assessments.

The full pressure-feature sensitivity matrix includes 4,320 individual assessments. Around 500 of these assessments were not required as some of the pressures were not considered to be relevant for MCZ features. The study has provided assessments for the great majority of the pressure-feature combinations with only a small percentage not determined on the grounds of insufficient information to attempt an assessment. Many of the assessments had to be based largely or solely on expert judgement owing to lack of specific evidence or knowledge or due to the requirement for rapid delivery which precluded evidence reviews. The audit trail for the matrix decisions are recorded in individual pro-formas for each feature.

Use of the Matrix, its Assumptions and Limitations

The main purpose of the pressure-feature sensitivity matrix is to support the process of identifying possible MCZ and the determination of appropriate conservation objectives and management measures. The matrix is, in effect, a preliminary risk assessment of the compatibility of specific pressure levels with the conservation of individual MCZ features. Where features are moderately or highly sensitive to the benchmark pressure levels, it is more likely that management measures will be required to support achievement of conservation objectives in situations where activities are occurring in proposed MCZ which give rise to comparable levels of pressure. Information on potential incompatibility may also be used to support site selection, for example, where there are choices for the location of an MCZ, it may be preferable to select sites with lower levels of incompatibility to minimise the socio-economic costs associated with network implementation.

Care needs to be taken in using the information in the matrix, as it provides only initial broad-brush risk assessments for what are typically complex and site-specific considerations. The assessments are based on the magnitude of pressures but do not take account of spatial or temporal scale. These factors should be taken into account in applying the sensitivity scores to MCZ/MPA planning processes. The consideration of the spatial scale of a pressure/activity should also take account of the spatial scale of the feature it might be affecting. Furthermore, the sensitivity scores are sensitive to the chosen benchmark level of pressure. In using the matrix outputs, particular attention should be paid to the magnitude of the local pressure being assessed.

For many of the habitat FOCI and broadscale landscapes, the sensitivity of the feature varies depending on the specific biotopes within that habitat or landscape that are being assessed. In such circumstances, the MCZ/MPA regional projects may therefore need to obtain better information on the types of features being affected to support decision making.

The sensitivity assessment methodology takes account of both resistance and resilience (recovery). Recovery pre-supposes that the pressure has been alleviated but this will generally only be the case where management measures are implemented. This should be taken into account when considering possible requirements for management measures, for example, by examining the resistance score as well as the overall sensitivity score.

A further limitation of the methodology is that it is only able to assess single pressures and does not consider the cumulative risks associated with multiple pressures. When considering multiple pressures of the same or different type at a given location, a judgment will need to be made on the extent to which those pressures might act synergistically, independently or antagonistically.

An expert-judgement based approach was chosen as a method that would allow rapid completion of the matrix and ensure that assessments were supported by experts. The assessments are therefore based primarily on expert judgment and it should be recognised that there are limitations to this approach, including the availability of experts to undertake assessments, the lack of consensus between experts and differences in the evidence base that experts are able to call on when making judgements. Significant gaps in the evidence available to experts exists, for example in relation to aspects of the biology of MCZ/MPA features, particular for deep-sea features. There are also significant gaps in scientific understanding of the magnitude of some pressures and the associated environmental effects on MCZ/MPA features, for example, litter, electromagnetic fields, underwater noise and the introduction of light.

The confidence assessments indicate the relative strength of the evidence base underpinning the sensitivity assessments. Where confidence scores are low this should be taken into account in decision-making but, in line with the precautionary principle, lack of evidence should not be a reason for not taking action.

Links to Other Matrices

The pressure-feature sensitivity matrix is part of the overall tool being developed to support sensitivity assessments within the context of regional MCZ projects. An activity-pressures matrix is being developed by JNCC in consultation with NE and the Regional MCZ projects which links pressures to specific activities. Based on the linkages between the pressures-features and pressures-activities matrices, an activity-features tool will then be produced which links the sensitivity of MCZ/MPA features to specific activities.

Conclusions and Further Considerations

The methodology has been used to carry out around 4000 individual sensitivity assessments for MCZ/MPA features against a set of pressure benchmarks. It provides a simple risk assessment and represents an initial stage in the evaluation of the sensitivity of features to human pressures. In seeking to apply the pressure-feature sensitivity matrix, users need to be fully aware of the limitations of the assessments described above.

To support MCZ Regional Projects in applying the study outputs, this report contains advice on how to use the matrix. However, to ensure consistency of approach, it may be appropriate for the statutory agencies (JNCC and Natural England) to provide more specific guidance on the use of the matrix. This guidance might also usefully identify the relationships between the different matrices being produced.

In applying the matrix, it might also be helpful to establish a process through which new evidence and practical experience could be used to update and improve existing assessments and their confidence. This should include a process for quality assuring new information and updating the matrix in a controlled manner (i.e. version control as part of a wider quality management system).

More widely the pressures-features sensitivity matrix can provide a resource to support broader conservation and marine spatial planning initiatives. To increase its usefulness, the matrix might be extended to include a wider range of marine features, for example, marine mammals, turtles, birds, fish, cephalopods. It may also be appropriate to take forward work to develop benchmarks where these do not currently exist, for example, litter.

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Annexes

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1. Introduction

1.1 Biophysical Data Layers Project

1.1 The UK is committed to the establishment of a network of marine protected areas (MPAs) to help conserve marine ecosystems and marine biodiversity. MPAs can be a valuable tool to protect species and habitats and can also be used to aid implementation of the ecosystem approach to management, which aims to maintain the 'goods and services' produced by the healthy functioning of marine ecosystems that are relied on by humans.

1.2 As a signatory of the OSPAR Convention the UK is committed to establishing an ecologically coherent network of well-managed MPAs. The UK is already in the process of completing a network consisting of Special Areas of Conservation (SACs) and Special Areas of Protection (SPAs), collectively known as Natura 2000 sites to fulfil its obligations under the EC Habitats Directive (92/43/EEC) and EC Birds Directive. Through provisions in the Marine and Coastal Access Act 2009, Marine Conservation Zones (MCZs) may be designated in English and Welsh territorial waters and UK offshore waters. The Scottish Government is also considering equivalent Marine Protected Areas (MPAs) in Scotland. These sites are intended to help to protect areas where habitats and species are threatened, and to also protect areas of representative habitats. For further information on the purpose of MCZs and the design principles to be employed see http://www.defra.gov.uk/environment/biodiversity/marine/documents/guidance-note1.pdf Defra, 2009.

1.3 MCZ selection will be undertaken via a participatory stakeholder engagement approach. Four regional MCZ projects have been established to lead this process. Regional projects commenced in February 2010 and will submit the possible MCZs they have identified to JNCC and NE in June 2011. A formal public consultation is expected in 2012.

1.4 Selection of MPAs should be based on the best available information from a wide range of sources including biological, physical and oceanographic characteristics and socio-economic data such as the location of current activities. To ensure such data are easily available to those who would have responsibility for selecting sites, Defra and its partners[2] commissioned a consortium lead by ABPmer Ltd and partners to take forward a package of work. New Geographical Information System (GIS) data layers to be developed included:

- Geological and geomorphological features;
- Habitats and species of conservation importance;
- Sea bed energy;
- Marine diversity layer;
- Benthic productivity; and

[2] Joint Nature Conservation Committee (JNCC), Countryside Council for Wales (CCW), Natural England (NE), Scottish Government (SG), Department of Environment Northern Ireland (DOENI) and Isle of Man Government.

- Residual current flow.

1.5 In addition to the development of data layers, there is a need to ensure such information can be easily accessed through a webGIS given the participatory nature of the MCZ process that is currently being planned.

1.6 This report provides a detailed description of the development of a pressure-feature sensitivity matrix.

1.2 Aims and Objectives

1.7 The three objectives for the study are:

- To develop methods for developing a matrix (the pressure-feature sensitivity matrix) describing the sensitivity of features to pressures through a workshop based approach for all EUNIS Level 3 broad-scale habitats, OSPAR threatened and/or declining habitats and species and the UK BAP habitats and species listed in Annex A.
- Achieve consensus through a workshop approach to the sensitivity scores for marine features and pressures.
- To produce a technical report describing the method used for developing the pressures-features sensitivity matrix, and a confidence assessment for each benchmark.

1.8 It is intended that the users of this output will be the Statutory Nature Conservation Bodies (SNCBs), Defra, Scottish Government, the Welsh Assembly Government and the regional MCZ projects in taking forward the designation of Marine Conservation Zones or Scottish nature conservation MPAs. It also intended that the table may have longer term application for use by Government Departments, and may be further built on in the future.

1.3 Format of Report

1.9 This report comprises 8 main sections and 8 annexes. The sections comprise this introduction

- Section 1 - This Introduction section;
- Section 2 - An overview of the approaches and methods used;
- Section 3 - Definition of terms associated with sensitivity and a brief outline of similar approaches, previously developed and which informed development of the pressure- feature sensitivity matrix;
- Section 4 - Describes the development of the pressures and pressure benchmark categories;
- Section 5 - Provides a detailed outline of the sensitivity assessment methodology and application through workshops.
- Section 6 - Discusses the application of the matrix, limitations and information gaps);
- Section 7 - Outlines links to other matrices under development; and
- Section 8 - Contains conclusions and further considerations

2. Adopted Approach and Methodology

2.1 The objective of the project was to develop a pressure-feature sensitivity matrix, through a three-stage process, that describes the relative sensitivities of a list of key marine habitats and species, including EUNIS Level 3 broad-scale habitats, OSPAR threatened and/or declining habitats and species and the UK BAP habitats and species, to specified pressures (see Section 4 and Annex C). These stages are described below and include the development of a methodology to determine the sensitivity of key habitats and species through a workshop based approach, two facilitated workshops involving experts in marine pressures and ecology of marine features, and thirdly the production of the sensitivity matrix and associated audit trail including confidence assessment. The intention was that the matrix would provide sensitivity scores and benchmarks for each feature against a series of environmental pressures.

2.1 Stage 1: Pre-workshop

2.2 In the first stage of the project pressure benchmarks were developed for each of the pressures that were to be assessed. Two 'benchmarks' were provided, where possible, for each pressure, where the benchmarks describe the breakpoints between high-medium-low intensity of the pressure (see Annex C for benchmarks and medium pressure definitions). The pressure intensity between the two benchmarks (i.e. the medium pressure) was used to assess the sensitivity of the features.

2.3 In order to meet the project time scales and available resources, the project required a pragmatic and high level approach to the assessments which was suitable for deliberation within an expert workshop format. The methodology developed is described in further details in Section 5. Briefly features were categorised on a 4-point semi-quantitative scale for both their tolerance of the medium pressure benchmark (defined as resistance) and the ability to recover from the subsequent impact (defined as resilience). The information on resistance and resilience was combined consistently to assess sensitivity, scored as 'high', 'medium', 'low' or 'not sensitive'.

2.4 The draft methodology and pressure benchmarks were reviewed by the Project Steering Group and Science Advisory Panel.

2.5 The pressure-feature sensitivity matrix was block-filled with existing assessments where relevant to the pressure/feature combination. Information on the blockfilling process where features were assessed as 'Not Exposed' or Not Sensitive' is described in Section 5.5 and Annex E.

2.2 Stage 2: Facilitation of Expert Workshops for Population of the Pressures-Sensitivity Matrix

2.6 In the second stage, two expert workshops were convened to undertake sensitivity assessments to complete the population of the matrix and to provide feedback on the application of the methodology and pressure benchmarks. The first workshop was held in Peterborough on 8/9th July 2010, attended by statutory nature conservation body (SNCB) staff and experts in the marine ecology of features. The second workshop was held in London on 28/29th July 2010, attended by experts from industry. A further small workshop was held in Plymouth on 31st July for marine ecology experts that were not able to attend the Peterborough workshop. Annex F contains the workshop reports which include a list of the organisations that the participants represented.

2.7 Using the assessment methodology, the workshop delegates worked in groups to assign sensitivity scores for each pressure/feature combination, that hadn't been blockfilled. The sensitivity score for each pressure/feature combination (i.e. either a pressure/habitat combination, or a pressure/species combination), relates to the medium pressure intensities (Section 4). Recorders were provided to each group, to complete audit trail recording forms which record the reasons for the decisions made (see Annex G). To support decision making and recording a range of materials were provided to each group, including:

- Pressures benchmarks table;
- Sensitivity assessment methodology;
- Step by step simple methodology outline;
- Features and biotope table (showing constituent biotopes);
- Audit record sheets specific to each feature (blocked according to draft matrix assessments) as paper and electronic copies;
- Draft pressure-feature sensitivity matrices;
- Tables of features grouped to workshop sessions; and
- Information on resistance and resilience for features from MarLIN (where reviews had been undertaken).

2.3 Stage 3: Post-Workshops

2.8 In the third stage, the information from the workshops was reviewed and collated into the pro-formas (Annex G) and remaining gaps were completed by the project team in consultation with external experts to provide a draft final matrix and pro-formas. The matrix and pro-formas were circulated to the PSG and SAP for review and comment prior to its finalization. A draft of this report was also prepared describing the background to the study, the methodology and key findings. This was also circulated to the PSG and SAP prior to its finalisation.

3. Background Review – Sensitivity Categories

3.1 The project began with the production of a literature review that described and compared different approaches that have been adopted to assess sensitivity in the marine environment. The findings from the review and ways to progress the project were considered and discussed at a workshop in May 2009. This workshop provided consensus definitions of sensitivity that were later used to develop the assessment methodology that is described fully in Section 5. This section of the report outlines the definition of sensitivity and the associated concepts resistance and resilience (Section 3.1).

3.1 Defining ‘Sensitivity’, ‘Resistance’ and ‘Resilience’

3.2 Holt *et al*. (1995) defined sensitivity as ‘the innate capacity of an organism to suffer damage or death from an external factor beyond the range of environmental parameters normally experienced’. The UK Review of Marine Nature Conservation (Defra, 2004), further revised the definition of sensitivity to be ‘dependent on the intolerance of a species or habitat to damage from an external factor and the time taken for its subsequent recovery’. Intolerance was defined as the ‘susceptibility of a habitat, community or species to damage, or death, from an external factor’, and recoverability is the ‘ability of a habitat, community or species to return to a state close to that which existed before the activity or event caused change’ (Hiscock and Tyler-Walters, 2006). Sensitivity therefore encompasses a measure of the effect of a pressure (sometimes referred to as disturbance, perturbations or stress), on a receptor (see Table 1 for definitions of key terms). The degree of effect of an impact will depend on the tolerance (conversely, the intolerance) of the receptor.

3.3 The concepts of resistance and resilience are widely used to assess sensitivity. These attributes were described by Holling (1973) for systems in general, where resistance refers to the ability to absorb disturbance or stress without changing character and resilience describes the speed at which the system returns to its previous state when changed. Resilience can therefore be thought of as synonymous with the ability of a system to recover from a perturbation, which some studies have referred to as ‘recoverability’ (Holt *et al* 1997). The OSPAR commission use these concepts to evaluate sensitivity as part of the criteria used to identify ‘threatened and declining’ species and habitats within the OSPAR region - the Texel-Faial criteria. A species is defined as very sensitive when it is easily adversely affected by human activity (low resistance) and/or it has low resilience (recovery is only achieved after a prolonged period, if at all). Highly sensitive species are those with both low resistance and resilience.

3.4 The workshop held as part of the initial review of methodologies agreed that any assessments of sensitivity of features to support MCZ planning should consider both resistance and resilience. The review of sensitivity approaches, however, identified that assessments of sensitivity, differ in the attributes of the system or components that are chosen to represent resistance or resilience. Resistance may be measured using proxies such as fragility or other traits that are known to influence tolerance/intolerance. Recoverability, in turn, may be measured in regard to the return to a benchmark that was established prior to the pressure occurring in an area, or based on unimpacted populations/locations. This benchmark may be the abundance of a species, the diversity or biomass of a community etc.

3.1.1 Pressures, Impacts and Exposure

3.5 Human activities can result in a number of pressures, which may impact sensitive environmental components. Pressures have been defined as ‘the mechanism through which an activity has an effect on any part of the ecosystem’ (Robinson *et al*. 2008). Pressures can be physical, chemical or biological (see Section 4). The same pressure can be caused by a number of different activities, e.g. fishing using bottom gears and aggregate dredging both cause abrasion; a habitat damage pressure (Robinson *et al*. 2008). Impacts are defined as the consequences of these pressures on components where a change occurs that is different to that expected under natural conditions. Different pressures can result in the same impact, for example, habitat loss and habitat structure changes can both result in the mortality of benthic invertebrates (Robinson *et al*. 2008).

Table 3.1: Definition of sensitivity and associated terms

Term	Definition	Sources
Sensitivity	A measure of tolerance (or intolerance) to changes in environmental conditions.	Holt *et al*. (1995), McLeod (1996), Tyler-Walters *et al*. (2001), Zacharias & Gregr 2005).
Resistance (Intolerance/ tolerance)	Response to change whether element can absorb disturbance or stress without changing character.	Holling (1973)
Resilience (Recoverability)	The ability of a system to recover from disturbance or stress.	Holling (1973)
Vulnerability	Vulnerability is a measure of the degree of exposure of a receptor to a pressure to which it is sensitive.	Based on Hiscock (1996). Oakwood Environmental Ltd (2002).
Pressure	The mechanism through which an activity has an effect on any part of the ecosystem’. The nature of the pressure is determined by activity type, intensity and distribution.	Robinson *et al*. (2008)
Impact	The effects (or consequences) of a pressure on a component.	Robinson *et al*. (2008)
Exposure	The action of a pressure on a receptor, with regard to the extent, magnitude and duration of the pressure.	Robinson *et al*. (2008)

3.1.2 Vulnerability

3.6 The degree of vulnerability of a habitat is a product of sensitivity (a measure of resistance and resilience) and exposure. A habitat, community or species becomes ‘vulnerable’ to adverse effect(s) when it is sensitive and the external factor is likely to happen (Holt *et al*. 1995, Tyler-Walters *et al*. 2001, Oakwood Environmental Ltd 2002). If a component is not sensitive to a pressure then it is not vulnerable. For example, a certain habitat type may be highly sensitive to fishing activities, but if it occurs in an area where there was never any fishing activity it would not be vulnerable. Alternatively, a habitat that is less sensitive to fishing activities, that is in an area where it is repeatedly exposed to fishing, is vulnerable to some degree.

3.7 As the intensity and/or duration of the impact (the exposure) determines the magnitude of effect, measures of vulnerability often take into account the probability of an impact and the probable characteristics of impacts, i.e. by classing vulnerability according to different intensity regimes (Oakwood Environmental Ltd, 2002).

3.8 This project has assessed the sensitivity of features, work to link these sensitivities and exposure to pressures to assess vulnerability will be taken forward by later projects.

3.2 Brief Review of Approaches

3.9 A number of previous studies have sought to develop approaches to sensitivity assessment as outlined below:

- MarLIN (Marine Life Information Network) bhave defined sensitivity and associated terms. They have also developed an approach to sensitivity assessment based on selected species[3].
- CCW have developed the Beaumaris approach which focused on the sensitivity of benthic habitats to fishing activities around the Welsh coast and coastal waters. They compared the severity of a fishing event at four levels of intensity against the rate of habitat recovery to derive a habitat sensitivity score (high, medium or low). The study included 30 habitat categories and used two matrices which contained three main components; the intensity of the disturbance and the spatial footprint of the disturbance (which were used together to assess the severity of the disturbance event) and the rate of recovery from the disturbance;
- Robinson *et al*. (2008) developed an assessment methodology which was used for OSPAR and Charting Progress II. This assessment was based on expert-judgement and follows the DPSIR (Drivers-Pressures-State-Impacts-Responses) framework;
- As part of an assessment of cost impacts of Marine Bill biodiversity proposals for Defra, an initial methodology to identify requirements for management measures in possible MCZs has been developed. This was based on identification of the likely impacts of a range of relevant human activities on designated features (Defra, 2007);
- Natural England produced a report assessing the compatibility of activities within future MCZs. This work produced two high level compatibility matrices, one for a theoretical highly restricted site and one for a partially restricted site, which illustrate the likely spectrum of management regimes represented across future the MCZ network. The effect of various coastal and marine activities was scored as being compatible, incompatible or of

[3] http://www.marlin.ac.uk/sensitivityrationale.php

possible compatibility with a range of identified habitat and species groups[4]; and

- ABPmer and MarLIN have conducted a review of the different sensitivity assessment approaches.

3.10 The specification required that these previous studies must be taken into account in this study to avoid any repetition of work that has already been done. However, the emphasis in this project should be to use the knowledge gained from these previous studies to deliver a new product. The MarLIN and Beaumaris approach (which in turn were developed from the SensMAP approach) were broadly adopted to develop the pressures-features sensitivity matrix (as described in Section 5).

4 Internal unpublished work by Natural England.

4. Background Review – Pressures Categories and Benchmarking Outcomes

4.1 Background to Benchmark Categories

4.1 A wide range of initiatives have sought to categorise human pressures in the marine environment including:

- Charting Progress 2 (Robinson *et al*, 2008; UKMMAS, 2010);
- OSPAR Quality Status Report (Robinson *et al*, 2008);
- Marine Strategy Framework Directive;
- Natura 2000 pressure themes;
- Offshore Natura 2000 pressure themes; and
- Marine Policy Statement (HM Government, 2010b).

4.2 In seeking to take forward the development of a pressures-features sensitivity matrix, it is important to seek to ensure that a consistent approach to pressure categorisation is adopted which builds upon existing initiatives and can be readily translated to meet specific reporting requirements for individual initiatives.

4.3 To support the development of the pressures-features sensitivity matrix, JNCC have undertaken a review of existing pressure categorisations and developed a list of 39 pressures for inclusion in the matrix (Table 4.1 shows the list of these as provided to ABPmer and MarLIN). ABPmer developed pressure benchmarks for these, as appropriate, as detailed in section 4.2 and shown in Annex C, Table C1.

Table 4.1: Initial list of pressures for inclusion in the pressures-features sensitivity matrix

Pressure theme	Pressure
Climate change	Atmospheric climate change
	pH changes
	Temperature changes - regional/national
	Salinity changes - regional/national
	Water flow (tidal & ocean current) changes - regional/national
	Emergence regime changes (sea level) - regional/national
	Wave exposure changes - regional/national
Hydrological changes (inshore/local)	Temperature changes - local
	Salinity changes - local
	Water flow (tidal current) changes - local
	Emergence regime changes - local
	Wave exposure changes - local
	Water clarity changes
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)
	Synthetic compound contamination (incl. pesticides, anti-foulants; pharmaceuticals)
	Radionuclide contamination
	Introduction of other substances (solid, liquid or gas)
	De-oxygenation

Pressure theme	Pressure
	Nutrient enrichment
	Organic enrichment
Physical loss	Physical loss (to land or freshwater habitat)
	Physical change (to another seabed type)
Physical damage	Habitat structure changes - removal of substratum (extraction)
	Penetration and/or disturbance of the substrate below the surface of the seabed
	Heavy abrasion, primarily at the seabed surface
	Light abrasion at the surface only
	Siltation rate changes
Other physical pressures	Litter
	Electromagnetic changes
	Underwater noise changes
	Introduction of light
	Barrier to species movement
	Death or injury by collision
Biological pressures	Visual disturbance
	Genetic modification & translocation of indigenous species
	Introduction or spread of non-indigenous species
	Introduction of microbial pathogens
	Removal of target species
	Removal of non-target species

4.2 Benchmark Development

4.4 To support matrix development, pressure definitions and benchmarks have been established for each of the pressures identified in Table 4.1. In consultation with the Project Steering Group it was agreed to split the 'siltation rate changes' pressure into two sub-categories 'low' and 'high' to better reflect the range of variation in pressure.

4.5 Where practicable three benchmarks have been developed for each pressure, where the benchmarks describe the breakpoints between high/medium and medium/low pressure intensity and the mid-point between these two benchmarks (defined as medium pressure). The latter has been used for assessing the sensitivity score within the overall sensitivity matrix.

4.6 Information for benchmark development has been drawn from a number of sources, including:

- existing benchmarks from other sensitivity assessments (MarLIN website);
- environmental quality standards (for example, water quality standards established under the EC Water Framework Directive (2000/60/EC);
- guideline values for concentrations of contaminants in sediment and biota (e.g. OSPAR environmental Assessment Criteria (EAC's), Canadian Interim Sediment Quality Guidelines (ISQGs);
- initial thresholds developed for indicators of Good Environmental Status under the EC Marine Strategy Framework Directive (2008/56/EC) (Cardoso *et al*, 2010);
- climate change projections (UKCP09);
- expert knowledge of the nature and scale of hydrological changes associated with marine infrastructure developments in UK waters;

4.7 Initial draft benchmarks were reviewed by the Project Steering Group and the Science Advisory Panel. Testing and further review occurred through the workshops (Annex E). Experience with the application of the benchmarks at the workshops led to changes in the descriptions for a number of the benchmarks including:

- pH;
- penetration and abrasion benchmarks;
- introduction of non-native species; and
- removal of target and non-target species.

4.8 In developing the proposed benchmarks the different levels of information that are available for individual pressures were recognised to ensure that the benchmarks were defined in ways that could be readily applied by those undertaking more detailed site-based assessments. Where appropriate the benchmarks also draw on approaches that have been developed for the management of existing national and internationally designated sites where relevant.

4.9 For example, for many of the water quality pressures, there are established environmental quality standards (EQS) and extensive environmental monitoring of compliance against those standards. The EQS are set to provide a high level of environmental protection such that where waters comply with those standards, risks to features of conservation interest should be minimal. Thus, where there is good information on the spatial distribution and intensity of a pressure (which changes relatively little over time) and a clear standard for which environmental risks are known, this standard can be used as a benchmark and the monitoring data can be used to identify spatial risk. Such an approach has also been used to support the Review of Consents process under the Habitats Regulations.

4.10 For climate change pressures, it was felt sensible to adopt the high, medium and low emission scenarios (of UKCP09) as the Low/Medium, Medium and Medium/High intensity of the pressure. The benchmark then refers to the currently predicted changes in climate change related pressures. Through discussion with delegates at the workshops and from reviewers comments the sensitivity of some features to the pressure benchmark was recognised. However within the time and resource constraints it was not possible to consistently review the evidence for pH impacts. As no assessments had been made for this pressure at the workshops the sensitivity matrix was block- filled as 'not assessed' for this pressure (see Section 5.5).

4.11 For other types of pressure (for example, physical abrasion), less is known about the spatial distribution of the pressure or environmental sensitivities to different intensities of pressure. Furthermore, the location and intensity of such pressures vary considerably in space and time. While benchmarks can be set, there is limited environmental data to inform assessments. The risk assessment therefore needs to be centred around the presence of a certain pressure associated with an activity rather than in relation to a precise quantification of pressure intensity. The discussions at workshop 2 were particularly helpful in developing a clearer set of benchmarks for penetration and abrasion, essentially all related to the depth of penetration as an indication of the magnitude of the pressure.

4.12 Establishing definitions and benchmarks for removal of target and non-target species proved challenging. Removal of target species has been defined as commercial scale harvesting of MCZ features (species or habitat, for example, extraction of maerl) or characterising sub-features of a habitat or marine landscape (for example, cockles, as a characterizing feature of some subtidal sand habitats). Removal of non-target species has been defined as the removal of characterizing elements of habitats or marine landscapes associated with commercial harvesting activities (for example trawl by-catch).

4.13 For the introduction on non-native (non-indigenous) species, existing risk assessments have generally focused on the presence of pathways by which such species may be introduced (for example, Olenin *et al*, 2010). Given the widespread nature of such pathways, particularly in coastal waters, such an approach is of limited use in determining relative risk. The pressure benchmark adopted for this study has therefore also sought to identify habitat FOCI and broadscale habitats that may be at particular risk of impact by identifying a key set of invasive non-indigenous species (INS) for which documented evidence of significant impacts in UK waters exists (see Annex C Table C.3). In adopting this approach, it is recognised that it is to some extent subjective in determining which species are responsible for adverse impacts. Nor does the approach take account of possible future risks from candidate INS such as *Botryloides violaceus*, *Rapana venosa* (veined rapa whelk) and *Corella eumyota*.

4.14 For a number of pressures (for example, litter and the introduction of light), while it is possible to identify theoretical risk pathways, it is not currently possible to set benchmarks because (a) there is inadequate information on the intensity of the pressure in the marine environment and (b) little if any quantification of the sensitivity of relevant features to different levels of pressure. These pressures were therefore not assessed in this study, although it may be possible to develop benchmarks and sensitivity assessments for these pressures in the future, as scientific knowledge improves.

4.15 For certain other pressures (visual disturbance, underwater noise) currently available scientific information suggests that the MCZ features which are the subject of this assessment are generally not sensitive to these pressures. Therefore, no assessment against these pressures has been made (with the exception of fish species FOCI in relation to underwater noise). The pressures are relevant for other types of marine features, for example, marine mammals, turtles, sea birds, cephalopods and fish and assessments could be made for these features should the matrix be developed further.

4.16 Annex C presents the final pressure definitions and benchmarks adopted for the pressure-features sensitivity assessment and the justification for these.

5. Development of Pressures- MCZ Features Sensitivity Matrix

5.1 This section of the report outlines the assessment methodology (Section 5.1), an explanation of the resistance and resilience scales (Section 5.2), describes how these are combined to provide a sensitivity assessment (Section 5.3) and the confidence assessment methodology (Section 5.4). Section 5.5 discusses how the pressures-MCZ features matrix was initially blocked to identify features that were not assessed, not exposed or not sensitive. Reports on the two expert workshops that were held to assess feature sensitivity are described in Section 5.6. Conclusions are presented in Section 5.7.

5.2 The project specification was to develop a method of assessing the sensitivity of features that would allow rapid assessment of sensitivity by expert-judgement in workshop settings. Limited time was available for the development and testing of the approach, and it was clear that the approach should be based on established assessment methodologies that have been previously tested. In particular Hollings (1973); MarLIN (Hiscock & Tyler-Walters 2006; Tyler-Walters *et al*. 2009); OSPAR Texel-Faial Criteria (OSPAR 2003); the CCW 'Beaumaris approach' (Hall *et al*., 2008); Robinson *et al*. (2008) and the Review of Marine Nature Conservation (Laffoley *et al*., 2000). The methodology is therefore not a novel approach to assessing sensitivity. The approach was reviewed and approved by an independent panel of scientific experts as answering the purposes of the project and was tested on broadscale habitats, habitats and species prior to use in the workshops by the contractors to ensure that the outputs reflected their understanding of the sensitivity of selected features.

5.3 The approach considers the resistance (tolerance) and resilience (recovery) of a feature to assess sensitivity to pressures. The final sensitivity assessment methodology was developed to address the requirement to make rapid assessments using an expert-based approach. These sensitivity assessments were used to populate the pressures x features matrix (Annex B).

5.1 Sensitivity Assessment Methodology

5.4 Sensitivity assessment involves the following stages:

- **A** Definition of the key elements of the feature
- **B** Assessment of the feature resistance (tolerance) to a defined intensity of pressure (the benchmark intensity);
- **C** Assessment of the resilience (recovery) of the feature; and
- **D** The combination of resistance and resilience to derive an overall sensitivity rank.

5.1.1 Definition of Key Elements of the Feature

5.5 In order to assess sensitivity, elements of the feature must be selected as the basis of the assessment. The approach suggested is intended to be flexible and pragmatic and to be based on expert judgement of the feature. The approach is informed by other methodologies.

5.6 For species the selection is relatively straightforward; a theoretical population of the species in the middle of its environmental range is used as the basis of the assessment. As Holt *et al*. (1995) have pointed out, organisms near the limits of their range are more sensitive to change, so that sensitivity assessments should concentrate on sensitivities in 'mid-range' or typical habitats. The shore crab *Carcinus maenas*, for example, occurs in a range of habitats from fully marine to brackish. At some point salinity levels will limit its penetration into estuaries but it should not be classed as a species that is sensitive to salinity. However southern species that reach their northerly range limit in British waters will be sensitive to small decreases in temperature, although in their more typical southerly habitats, such species would not be considered to be sensitive to temperature. Assessments of sensitivity in British waters should consider these species as sensitive to temperature changes.

5.7 The sensitivity of a biological assemblage e.g. the full complement of organisms at a location is a function of the sensitivities of the constituent species populations. Seabed habitats can be highly diverse and the identity of many of the species present may vary between habitats that are classified as being of the same type. Basing an assessment of habitat sensitivity on the full biological assemblage is not appropriate (or possible given the current evidence basis) and therefore a rationale to select species populations for assessment is required.

5.8 For habitats, in general the assessment was guided by the presence of key structural or functional species and/or those that characterise the habitats (for definitions see Table 5.1). This does not suggest that only these species were considered in the assessments but that the importance of such species to maintaining and/or characterising the habitat was recognised. The loss of key and characterising species is considered to represent a severe impact to the condition of the habitat as these populations are important to define the character of the habitat and their loss would result in disproportionate changes to the character and/or function of the habitat. For example, the loss of horse mussels (*Modiolus modiolus*) from the Horse Mussel Bed feature would result in a re-classification of this habitat type. Similarly there are a number of other habitats of conservation importance included in the matrix which are defined by the presence of certain species e.g. flame shell beds, *Musculus discors* beds, deep-sea sponge aggregations and maerl beds where the sensitivity of a single species is of primary interest (although it is recognised that other species may also be important for maintaining the population of interest through trophic links, habitat provision etc.). The species that are used to base the confidence assessment for habitats and broad-scale habitats prior to, and at the workshops, should be indicated in the audit trail (Step 4). It should be noted that while these species are used to guide the assessment it is recognised that not all habitat features will contain easily identifiable key structural or functional species (although most will have a characteristic species assemblage). For habitats such as peat and clay exposures, intertidal underboulder communities and littoral chalk communities other elements of the habitat are more relevant to a sensitivity assessment, including impacts on physico-chemical elements such as substrate/sediment and other variables as discussed below. We have therefore developed a scenario approach for the sensitivity assessment where the sensitivity of the feature to a pressure takes into account effects on the species present and the habitat to deliver a more holistic assessment.

Table 5.1: Types of species identified for habitat assessment (Definitions adopted from MarLIN)

Category	Description
Key Structural Species	The species provides a distinct habitat that supports an associated community. Loss/degradation of this species population would result in loss/degradation of the associated community.
Key Functional Species	Species that maintain community structure and function through interactions with other members of that community (for example, predation or grazing). Loss/degradation of this species population would result in rapid, cascading changes in the community.
Important Characteristic Species	Species characteristic of the biotope (dominant, and frequent) and important for the classification of that habitat. Loss/degradation of these species populations may result in changed habitat classification.

5.2 Assessment of the Feature's Resistance and Resilience to a Defined Intensity of Pressure (The Benchmark Intensity)

5.9 In each case, the resistance and resilience of the feature(s) is assessed against each pressure using available evidence and/or expert judgement. A series of benchmark levels of intensity have been developed for each pressure, where intensity reflects the magnitude, extent and duration of each pressure. The benchmarks are designed to provide a 'standard' level of impact against which to assess resistance (see Section 4). Elements from both the Hall *et al*. (2008) approach and the MarLIN scales (Tyler-Walters *et al*., 2001, 2005) were used to develop a resistance (tolerance) scale for the sensitivity matrix (Table 5.2).

5.10 The quality of the evidence base is one of the factors reflected in the confidence rating (Step 3) see Table 5.5 and 5.6.

Table 5.2: Suggested resistance scale for sensitivity matrix (adapted from Hall *et al*. 2008 and MarLIN)

Resistance (Tolerance)	Description
None	Key functional, structural, characterising species severely decline and/or physico-chemical parameters are also affected e.g. removal of habitat causing change in habitat type. A severe decline/reduction relates to the loss of 75% of the extent, density or abundance of the selected species or habitat element e.g. loss of 75% substratum (where this can be sensibly applied).
Low	Significant mortality of key and characterising species with some effects on physico-chemical character of habitat. A significant decline/reduction relates to the loss of 25%-75% of the extent, density or abundance of the selected species or habitat element e.g. loss of 25-75% substratum

Resistance (Tolerance)	Description
Medium	Some mortality of species (can be significant where these are not keystone structural /functional and characterising species) without change to habitat type. The ‘some mortality’ referred to in Table 2 for medium resistance relates to the loss of <25% of the species or element.
High	No significant effects to the physico-chemical character of habitat and no effect on population viability of key/characterising species but may affect feeding, respiration and reproduction rates.

5.11 In the ‘None’ category (Table 5.2) the scale incorporates the removal of habitat e.g. change in habitat type, from the Hall *et al*. (2008) approach (as reported in Abram *et al*. 2009). The high tolerance category is comparable in both approaches in that the impact is not linked to detectable mortality of individuals. Between these extreme points, low and medium resistance of habitat features are distinguished by the impact on keystone structural, functional and characterising species and habitat (physico-chemical) conditions. Lower resistance is also categorised by effects on the physico-chemical character of habitats, as changes in habitat type represent a more significant impact than pressures which do not result in changes.

5.12 The definitions provided include the semi-quantitative descriptors ‘severe’, ‘significant’ and ‘some’ decline/mortality etc. The definitions of these terms in this study are taken from the Texel-Faial criteria developed for OSPAR (2003).

5.2.1 Assessment of the Resilience (Recovery) of the Feature

5.13 Separation of recovery times into categories was undertaken with regard to the scales used by MarLIN and the Robinson *et al*. (2008) approach. The proposed resilience scale for the sensitivity matrix methodology takes into account the use of the sensitivity matrix for MCZ planning where short-term recovery rates of features are likely to be of interest in assessing compatibility of activities (Table 5.3). Therefore the separation between the category none, was reduced to 25 years rather than the >100 years used in Robinson *et al*. (2008) and the high recovery category was judged as 2 years recovery time, rather than the 5 years used by MarLIN. Hence, the proposed scale categorises recovery over shorter timescales than the MarLIN and Robinson *et al*. (2008) approaches.

5.14 ‘Full recovery’ is envisaged as a return to the state of the habitat that existed prior to impact. In effect, a return to a recognisable habitat and its associated community. However, this does not necessarily mean that every component species has returned to its prior condition, abundance or extent but that the relevant functional components are present and the habitat is structurally and functionally recognisable as the habitat of conservation concern.

5.15 It is noted that recovery to the pre-impact state may not take place for a number of reasons, including regional changes in environmental conditions. The assessment is therefore based on theoretical recovery rates, based on traits and available evidence for a species population or habitat where the activity has ceased.

Table 5.3: Resilience scale for sensitivity matrix

Resilience Category	Description
Very low	Negligible or prolonged recovery possible; at least 25 years to recover structure and function
Low	Full recovery within 10-25 years
Medium	Full recovery between 2- 10 years
High	Full recovery within 2 years

5.3 The Combination of Resistance and Resilience to Derive an Overall Sensitivity Rank

5.16 The combination of resistance and recovery is based on the Texel-Faial criteria and Laffoley *et al*., (2000), who define a sensitive species or habitat as:

A species/habitat is "sensitive" when:

a. it has low resistance (that is, it is easily adversely affected by human activity); and/or
b. it has low resilience (that is, after an adverse effect from human activity, recovery is likely to be achieved only over a long period).

5.17 The resistance and resilience categories guide the assessment of sensitivity as outlined below (Table 5.4).

Table 5.4: Combining resistance and resilience scores to categorise sensitivity

	Resistance			
Resilience	None	Low	Medium	High
Very Low	High	High	Medium	Low
Low	High	High	Medium	Low
Medium	Medium	Medium	Medium	Low
High	Medium	Low	Low	Not Sensitive

5.18 The sensitivity categories can broadly be described as follows:

High Sensitivity - a feature is assessed as having high sensitivity where the pressure causes severe or significant mortality of a species population (most individuals killed). Habitat features are highly sensitive where the pressure causes severe or significant mortality of key functional or structural species or those that characterise the habitat, and/or causes changes in the habitat such that environmental conditions are changed (e.g. the habitat type is changed). If recovery is possible, the feature is anticipated to take > 10 years to recover from the impacts caused by the pressure. An example would be a cold water coral reef, which is highly likely to be demolished by bottom trawling and would take in excess of a 100 years to recover its original extent and biodiversity.

Medium Sensitivity - features with medium sensitivity are those characterised by medium resistance and no to low recovery or no to low resistance and medium to high recovery. A possible example might be a muddy sand assemblage with some minor structural components that would be damaged by a single pass of a beam trawl followed by recovery within 2 to 10 years.

Low Sensitivity - features with low sensitivity are those with high resistance or where recovery from any impacts caused by pressure is rapid, so that the feature is recovered within two years from cessation of pressure causing activity. An example would be removal of ephemeral algae (e.g. Ulva) from the shoreline; species that would typically take 6-12 months to regain their original cover.

Not Sensitive - features that are 'not sensitive' are those where resistance to the pressure is high where there are no significant mortality of individuals or changes to the habitat, and where recovery from any impact is complete within 2 years.

Variability in Sensitivity

5.19 It was anticipated that the broad habitats (EUNIS Level 3) could encompass a range of habitats that could vary in sensitivity. In order to capture this, it was decided to report the range of sensitivity values where a range of habitat sensitivities occurred, and to flag up potential species and habitats of greater sensitivity in the explanatory text that accompanied the sensitivity assessment. The contractors were tasked to produce two matrices; one which contained the sensitivity range for pressure x feature combinations where a range of sensitivities had been described and one which showed only the highest sensitivity score. An asterisk (*) was used to denote that there was an underlying range of sensitivities for the feature. This matrix is available on request.

5.4 Confidence Assessments

5.20 Confidence scores have been assigned to the individual pressure-feature sensitivity assessments in accordance with the criteria in Table 5.5. The confidence assessment refers to the availability of information to support the sensitivity assessment and is therefore an indication of the quality of evidence that was available (Table 5.5). As the sensitivity assessment is based on a resistance and resilience score (or category) that are then combined the confidence of each assessment was recorded. These were combined to deliver the confidence assessment as below (Table 5.6), where the lowest confidence of the two scores was the confidence value assigned to the assessment. Where assessments produced a range of sensitivities (as described in the paragraph above) the range in confidence assessments was also displayed. The second pressures x features sensitivity matrix shows only the lowest confidence assessments with any range in assessments removed. An asterisk (*) was used to denote that there was an underlying range of confidence assessments for the feature.

Table 5.5: Confidence assessment categories for evidence

Evidence Confidence	Definition
Low Confidence - Evidence (LE)	There is limited or no specific or suitable proxy information on the sensitivity of the feature to the relevant pressure. The assessment is based largely on expert judgement.
Medium Confidence Evidence (ME)	There is some specific evidence or good proxy information on the sensitivity of the feature to the relevant pressure.
High Confidence- Evidence (HE)	There is good information on the sensitivity of the feature to the relevant pressure. The assessment is well supported by the scientific literature.

Table 5.6: Combined confidence assessments

	Resistance		
Recovery	**Low**	**Medium**	**High**
Low	Low	Low	Low
Medium	Low	Medium	Medium
High	Low	Medium	High

5.4.1 Confidence and Audit Trails

5.21 It is desirable that any approach used, and the sensitivity categorisations that are assigned to features, can be justified to stakeholders. An auditing approach was adopted for this project so that the results can be compared and are transparent and justifiable in the future. The basis of sensitivity decisions made by experts or those based on published evidence are recorded in pro-formas for each feature (Annex G) by recorders that had been briefed by the contractor and supplied with standard recording sheets. However, it is recognised that some pro-formas contain limited information. In some cases there may have been limited dialogue about feature sensitivity and the audit trails were supplied to ABPmer incomplete. Where confidence levels were not supplied with assessments, a low confidence was assigned. This is discussed further in Section 6.

5.5 Matrix Pressure Blocking

5.22 To identify the relevant features for the sensitivity assessment cells are ‘blocked’ with the category ‘No Exposure’ in the matrix where there will clearly be no exposure to a particular pressure, for example, deep mud habitats are not exposed to changes in emersion. Features that may avoid significant exposure to a pressure (e.g. deep burrowers may avoid damage from light abrasion) are captured in the resistance score within the detailed sensitivity assessment.

5.23 For some pressures the evidence base was not considered to be developed enough for assessments to be made of sensitivity, or it was not possible to develop benchmarks for the pressure or the features were judged not to be sensitive to the pressure e.g. visual disturbance. These assessments are marked as NA- not assessed in the matrix. The blocking is outlined in Annex E for each of the pressures.

5.24 For a limited number of features the assessment ‘No Evidence’ is recorded. This indicates that experts at the workshops were unable or unwilling to assess the specific feature/pressure combination based on their knowledge and that subsequently the contractor were also unable to locate information regarding the feature on which to base decisions. This was particularly the case for species with distributions limited to few locations (sometimes only one), so that even basic tolerances could not be inferred. However, systematic and substantial literature review was outwith the scope of this project (to develop the matrix using expert-judgement) and therefore an assessment of ‘No Evidence’ should not be taken to mean that there is no information available for features.

5.6 Workshops

5.25 As part of the matrix development ABPmer and MarLIN organised two, two-day workshops, from experts from research (workshop 1) and industry (workshop 2). The specific aims of the workshops were to, 1) provide an opportunity for comment on the overall methodology and review and modify pressure benchmarks and 2) provide sensitivity assessments based on expert judgement (supported by evidence where possible as experts had been asked to supply references).

5.26 Both workshops began with presentations from ABPmer on the pressures and pressure benchmarks and the methodology and delegates were provided with the opportunity to discuss these in question and answer sessions. Parallel breakout sessions were then held where groups of experts assessed the sensitivity of features. The 108 features were grouped according to broad similarities to allow experts to self-select into feature groups according to expertise and experience. As delegates became more experienced in applying the methodology the groups were further subdivided to allow more assessments to be made. Each group was supported by a recorder who had been briefed at a training session prior to the workshop. The role of the recorder was primarily to fill out the audit record sheets (paper or electronic) to capture the expert decisions. Approximately 530 assessments/reviews were made by experts at workshop 1, fewer assessments (approximately 120) were made at workshop 2. The recording sheets were returned to the contractor and used to update the pro-formas. The evidence base supplied in these to support assessments varies widely (as reflected in the proformas). In some cases assessments were accompanied by detailed evidence of the elements used, the basis of decisions made and supporting evidence (reports, scientific papers etc. supplied). In other cases the assessment evidence was limited and this may reflect gaps in the knowledge base of experts or that recorders had not been able to capture the full discussion and elements of assessments. In order to develop the matrix within the project timescales assessments were made rapidly and there may be some inconsistencies between application of methodology and recording (see Section 6).

5.27 The reports from both workshops including agendas, minutes and attendance that were submitted to the Project Steering Group are in Annex F.

5.7 Further Matrix Development

5.28 Following the workshops there were a number of assessment gaps in the sensitivity matrices and also- for a number of cells- cases where two different sensitivity assessments were made. Given the time and resource constraints for the project an extended literature review to fill gaps and resolve assessments was not possible. A number of experts were invited to review the matrices and this provided further assessments and in some cases supported assessment resolution as documented in the proformas. Some discrepancy should be expected between assessments carried out in different fora as assessments based on expert judgement are not fully replicable as they are influenced by group composition as a result of differences in knowledge base and experience (see Section 6.3). As the project specification was to use an expert-judgement based approach in workshops we have where possible incorporated the workshop assessments, except where the reviewer was an acknowledged expert in their field or could provide substantial evidence/experience. Inevitably some selections were subjective, these assessments were retained in proformas and reasons for selection given. Given the wide range of sensitivity assessments for seagrass it was not considered possible to select assessments, given the differences in opinion, these are therefore presented as a range and identified using a purple colour code in the matrix.

5.29 In a limited number of cases no assessments were made at the workshops or by expert review and these are labelled as not assessed in the matrix and the reason for the lack of assessment documented in the proformas.

6. The Matrix – How to Use it, Assumptions and Limitations

6.1 Considerations in the Use of the Matrix

6.1 The main purpose of the pressure-feature sensitivity matrix is to support the process of identifying possible MCZ and the determination of appropriate conservation objectives and management measures. The matrix is, in effect, a preliminary risk assessment of the compatibility of specific pressure levels with the conservation of individual MCZ features. Where features are moderately or highly sensitive to the benchmark pressure levels, it is more likely that management measures will be required to support achievement of conservation objectives in situations where activities are occurring in proposed MCZ which give rise to comparable levels of pressure.

6.2 However, caution needs to be applied in using the matrix outputs, for a number of reasons:

- The sensitivity assessments are generic and NOT site specific. They are based on the likely effects of a pressure on a 'hypothetical' population in the middle of its 'environmental range'[5];
- Sensitivity assessments are NOT absolute but are relative to the magnitude, extent, duration and frequency of the pressure effecting the species or community and habitat in question; thus the assessment scores are very dependent on the pressure benchmark levels used;
- The assessments are based on the magnitude of pressures but do not take account of spatial or temporal scale;
- The significance of impacts arising from pressures also needs to take account of the scale of the features;
- The sensitivity assessment methodology takes account of both resistance and resilience (recovery). Recovery pre-supposes that the pressure has been alleviated but this will generally only be the case where management measures are implemented;
- The sensitivity of some habitat FOCI and broad-scale habitats varies markedly depending on the specific biotopes with that habitat or landscape that are being assessed; and
- Limitations of the scientific evidence on the biology of features and their responses to environmental pressures on which the sensitivity assessments have been based.

6.1.1 Generic Nature of Assessments

6.3 Detailed assessment of environmental impacts is very much dependent on the specific local character of the receiving environment and associated environmental features. Generalization of impact assessments inevitably leads

[5] Where 'environmental range' indicates the range of 'conditions' in which the species or community occurs and includes habitat preferences, physic-chemical preferences and, hence, geographic range.

to an assessment of the average condition. This may over or under-estimate impact risks.

6.1.2 Sensitivity of Assessment Scores to Changes in Pressure Levels

6.4 Sensitivity assessments are not 'absolute' values but 'relative' to the level of the pressure. Assessment of sensitivity is very dependent on the benchmark level of pressure used in the assessment. The benchmarks were designed to represent a likely level of pressure, in relation to the likely range of activities that could cause the pressure. The benchmark provides a 'standard' level of pressure (and hence potential effect) against which the range of species and habitats can then be assessed. The benchmarks are intended to be pragmatic guidance values for sensitivity assessment, to allow comparison of sensitivities between species and habitats, and to allow comparison with the predicted effects of project proposals In this way, those species or habitats that are most sensitive to a pressure or range of pressures can be identified.

6.5 In translating from the generic assessments in the matrix to assessments at a site level, it is thus important that there is a good understanding of the level of actual pressure caused by an activity at a local level. If the pressure level is significantly different from the benchmark, the sensitivity score should be re-evaluated.

6.1.3 Spatial and Temporal Scale of Pressures

6.6 The sensitivity assessments provided relate to the magnitude of a pressure but it is not possible, as part of such a high level risk assessment, to incorporate elements of spatial or temporal scale. Thus in seeking to make use of the assessments at site level, it is also important to obtain further information on both the frequency and spatial extent of a pressure before discussing possible requirements for management measures. For example, deployment of a ship's anchor could cause damage through penetration of the sea-bed. However, the spatial extent of such damage may be very small and, on its own, of no particular consequence. However, if multiple anchoring events were occurring on a daily basis, the cumulative effect of such damage could be more significant.

6.1.4 Scale of Features Relative to Scale of Pressures

6.7 In considering possible requirements for management measures, it is also necessary to consider the scale of a pressure in relation to the scale of the features of conservation interest that it might affect. Thus, for example, the change in substratum type caused by the placement of scour protection around an offshore structure on a large subtidal sandbank feature may be of little consequence. However, should such scour protection be placed on a more spatially limited seagrass bed, this could result in the loss of a large proportion of the feature.

6.1.5 Assumptions About Recovery

6.8 The sensitivity assessment methodology takes account of both resistance and resilience (recovery). Recovery is assumed to have occurred if a species population and/or habitat returns to a state that existed prior to the impact of a given pressure, not to some hypothetical pristine condition. Furthermore, for habitats, we have assumed recovery to a 'recognisable' habitat, rather than presume recovery of all species in the community and/or total recovery to prior biodiversity.

6.9 Recovery pre-supposes that the pressure has been alleviated but this will generally only be the case where management measures are implemented. For certain resistance-resilience combinations, it may be possible to obtain a 'low' sensitivity score even where resistance is 'medium' or 'low', simply because of assumed 'high' recovery. The headline sensitivity assessment score might suggest that there was less need for management measures. However, in the absence of such measures the impacts could be significant and preclude achievement of conservation objectives. Therefore in considering the possible requirement for management measures users of the matrix should consider both the sensitivity assessment score and the separate resistance and recoverability scores. As a general rule, where resistance is 'low', the need for management measures should be considered, irrespective of the overall sensitivity assessment.

6.1.6 Variation in Sensitivity with Habitat FOCI and Broad-scale Habitats

6.10 For some of the habitat FOCI and broad-scale habitats, there is significant variation in the sensitivity of their component biotopes. This is reflected in the pressures-features sensitivity matrix by providing the range of sensitivity scores across the range of biotopes within the habitat. When seeking to apply the assessments at a site specific level, it may be possible to make use of more specific information on the biotopes present to better determine the need for management measures. The contractors were tasked to produce two matrices; one which contained the sensitivity range for pressure x feature combinations where a range of sensitivities had been described and one which showed only the highest sensitivity score. An asterisk (*) was used to denote that there was an underlying range of sensitivities for the feature.

6.1.7 Limitations of Scientific Evidence

6.11 The sensitivity assessment process chosen (and outlined above) provides a systematic approach for the collation of existing evidence and the use of expert judgements to assess resistance, recovery and hence sensitivity to a range of pressures. Expert judgement is required because the evidence base itself is incomplete both in relation to the biology of the features and understanding of the effects of human pressures.

Biology of MCZ/MPA Features

6.12 In the marine environment, there is a relatively good understanding of the physical processes that structure sedimentary and rocky habitats but understand biological processes less well. For example, sediment type in strongly correlated with water flow and wave energy and changes in hydrology will influence the sediment and hence the communities it is capable of supporting. In contrast, biological processes can be highly variable between sites and within assemblages, so that responses to impacts can be unpredictable.

6.13 In particular, there is a lack of basic biological knowledge about many of the species of conservation concern, or important species that make up habitats of conservation concern. For example, the life history (e.g. larval ecology) of species such as *Eunicella verrucosa*, *Atrina pectinata* and *Leptopsammia pruvoti*, and hence their recruitment and potential recovery rates, are poorly known. Even where life histories are well known and recovery rates might be expected to be good (due to highly dispersive and numerous larvae) other factors influence their recovery. For example, native oyster and horse mussel have not recovered from past losses due to a multitude of factors including poor effective recruitment, high juvenile mortality, continued impact, or loss of (or competition for) habitat.

6.14 Deep sea species and habitats have generally been less well studied than those in coastal areas and information both on their biology and their response to human pressures is limited. The assessments for these features therefore relied heavily on the expert judgment of deep-sea biologists.

Understanding the Effects of Pressures

6.15 There are significant limitations in understanding of the effects associated with some of the pressures. For example, there is a paucity of research concerning the effects of underwater noise or particle on marine invertebrates. While it is generally believed that invertebrates are relatively insensitive to these pressures, compared to other marine receptors such as marine mammals and fish, the evidence base for this is poor (Tasker *et al.*, 2010).

6.16 Galgani *et al* (2010) recently reviewed information on the prevalence of litter in the marine environment. This identified a lack of good quantitative data and an absence of studies concerning the effects of litter on marine invertebrates.

6.17 Potential effects from electromagnetic fields have been identified for a range of invertebrate species (ICES, 2003; Gill *et al*, 2005; OSPAR, 2008). OSPAR (2008) states that 'In regard to effects on fauna it can be concluded that there is no doubt that electromagnetic fields are detected by a number of species and that many of these species respond to them. However, threshold values are only available for a few species and it would be premature to treat these values as general thresholds. The significance of the response reactions on both individual and population level is uncertain if not unknown.'

6.18 There is very limited information on the effects of the introduction of light on marine invertebrates Tasker *et al* (2010) did not consider this pressure when developing indicators relating to the introduction of energy for the purposes of the Marine Strategy Framework Directive 'due partly to their relatively localised effects, partly to a lack of knowledge and partly to lack of time to cover these issues'.

6.2 Use of Confidence Scores

6.19 Notwithstanding the limitations of the evidence base, there is a large volume of general evidence to call on against which to make judgements on the most likely effects of pressures on species and habitats based on past experience; especially with respect to fishing, industrial effluents and accidents (e.g. oil spills). Most lacking are specific studies that look at the specific impacts of a given activity (or pressure) on a large number of species and habitats. While, such studies are available for the effects of fishing and pollutants, the effects of many pressures have to be inferred from the available evidence base, in the knowledge that the evidence base will continue to grow.

6.20 The sensitivity assessments are accompanied by confidence assessments which take account of the relative scientific certainty of the assessments on a scale of high, medium and low. The level of confidence should be taken into account in considering the possible requirements for management measures. In line with the precautionary principle, a lack of scientific certainty should not, on its own, be a sufficient reason for not implementing management measures.

6.3 Limitations – General

6.21 It follows from the above, that the sensitivity assessments presented in the matrix are general assessments that indicate the likely effects of a given pressure (likely to arise from one or more activities) on species or habitats of conservation concern. They need to be interpreted within each region against the range of activities that occur within that region and the habitats and species present within its waters.

6.22 In particular, interpretation of any specific pressure should pay careful attention to:

- the benchmarks used;
- the resistance, recovery and sensitivity assessments listed;
- the evidence provided to support each assessment; and
- the confidence attributed to that assessment based on the evidence.

6.23 It is important to note that benchmarks are used as part of the assessment process. While they are indicative of levels of pressure associated with certain activities they are not deterministic, i.e. if an activity results in a pressure lower than that used in the benchmark this does not mean that it will have no impact. A separate assessment will be required.

6.24 Similarly, all assessments are made based ‘on the level of the benchmark’. Therefore, a score of ‘not sensitive’ does not mean that no impact is possible from a particular ‘pressure vs. feature’ combination, only that a limited impact was judged to be likely at the specified level of the benchmark.

6.25 A further limitation of the methodology is that it is only able to assess single pressures and does not consider the cumulative risks associated with multiple pressures of the same type (e.g. anchoring and beam trawling in the same area which both caused abrasion) or different types of pressure at a single location (e.g. the combined effects of siltation, abrasion, synthetic and non-synthetic substance contamination and underwater noise). When considering multiple pressures of the same or different types at a given location, a judgment will need to be made on the extent to which those pressures might act synergistically, independently or antagonistically.

6.26 It should also be noted that the evidence provided, and the nature of the species and habitat features may need interpretation by experienced marine biologists. Regional projects should, therefore, turn to the marine biologists (preferably from different disciplines) within their teams for advice on interpretation or seek to engage scientists within stakeholder groups.

6.27 There are limitations to an expert-based approach to develop rapid assessments through workshops. Key experts may not be available (the project coincided with the time of year when many biologists are engaged in field experiments and sampling) or unable to attend workshops. In addition the knowledge base of experts may vary and in some cases may conflict with other experts. The decisions made in the workshops have been recorded as far as possible in the pro-formas (Annex G) but in some cases the records provided to the contractor may have been incorrect or incomplete and may not reflect the full discussions held in the breakout sessions.

6.28 Assessments made by experts are based on the knowledge and experience of the experts making them and therefore have a degree of subjectivity. This would also be the case for assessments undertaken through review of available evidence, as empirical evidence may be lacking or compromised in other ways e.g. experimental results not transferable between different locations, times of year etc. It should be recognised that different groups of experts considering the same feature may arrive at different assessments. Similarly the same group of experts may arrive at different assessments subsequently as experience and knowledge changes. It should therefore be recognised that expert-based assessments are not replicable and that decisions made by groups are not always transparent.

6.29 Although every attempt was made to ensure consistency of application (e.g. through briefing of workshop recorders and facilitators, delegate briefings, provision of workshop materials detailing methodology and the use of standard recording sheets) inconsistencies can arise in decision making through differences in interpretation of the methodology e.g. the resistance and resilience scales and pressure benchmarks.

7. Links to Other Tools Under Development

7.1 The pressure-feature sensitivity matrix is one of two matrices being developed to provide a sensitivity assessment tool within the context of regional MCZ projects. The other matrix and overall tool are:

- A pressures-activity matrix which links pressures to specific activities, for example, marine aggregate dredging would be linked to the pressure ‘habitat structure changes - removal of substratum’
- A features-activity tool which links the sensitivity of MCZ/MPA features to specific activities based on the linkages between the pressure-feature sensitivity matrix and activity-pressure matrix..

7.2 The pressure-activity matrix is being developed by JNCC in consultation with NE and the Regional Projects. The first version of this matrix was developed internationally through OSPAR, and in the UK through UKMMAS, led by JNCC. This matrix will indicate which pressures result from which activities. By definition an activity can cause one or more pressures and a pressure can result from one or more activities.

8. Conclusions and Further Considerations

8.1 Conclusions

8.1 A methodology for assessing the sensitivity of MCZ/MPA features to human pressures has been developed and applied through expert workshops to populate the pressures-features sensitivity matrix. It has been used to carry out around 4000 individual sensitivity assessments for MCZ/MPA features against a set of pressure benchmarks.

8.2 The methodology provides a simple, high-level risk assessment and represents an initial stage in the evaluation of the sensitivity of features to human pressures. In seeking to apply the matrix, users need to be fully aware of the limitations of the assessments including:

- The sensitivity scores are strongly influenced by the magnitude of the pressures. The scores represent judgements of sensitivity in relation to specific benchmark levels of pressure. Where the actual magnitude of pressure varies, features may be more or less sensitive to those levels of pressure. In applying the matrix, users therefore need to be careful in ensuring that the benchmark level of pressure is relevant to the activity they are assessing;
- The sensitivity scores are based solely on the magnitude of the pressures. Sensitivity will also vary as a function of the frequency and duration of the pressure and the spatial extent of the pressure. In applying the matrix, users should therefore consider the temporal and spatial aspects of a pressure/activity and also take account of the spatial scale of the feature being exposed to the pressure;
- The sensitivity assessment methodology takes account of both resistance and resilience (recovery). Recovery pre-supposes that the pressure has been alleviated but this will generally only be the case where management measures are implemented. For certain resistance-resilience combinations, it may be possible to obtain a 'low' sensitivity score even where resistance is 'medium' or 'low', simply because of assumed 'high' recovery. In considering the possible requirement for management measures users of the matrix should consider both the sensitivity assessment score and the separate resistance and recoverability scores. As a general rule, where resistance is 'low', the need for management measures should be considered, irrespective of the overall sensitivity assessment.
- For some of the habitat FOCI and broad-scale habitats, there is significant variation in the sensitivity of their component biotopes. This is reflected in the pressures-features sensitivity matrix by providing the range of sensitivity scores across the range of biotopes within the habitat. When seeking to apply the assessments at a site specific level, users should seek to make use of more specific information on the biotopes present to better determine the need for management measures.

- A limitation of the methodology is that it is only able to assess single pressures. When considering multiple pressures of the same or different types at a given location, a judgment will need to be made on the extent to which those pressures might act synergistically, independently or antagonistically.

8.3 The study has identified various limitations in the scientific evidence base for undertaking the assessments. In particular, information on certain aspects of the biology of some features is poor, particularly for deep-sea species which are relatively poorly studied. Scientific understanding of some of the pressures and their effects on MCZ/MPA features is also poor, for example, litter, introduction of light, electro-magnetic fields and underwater noise. It has therefore not been possible to undertake assessments for these pressures.

8.4 The sensitivity assessments are accompanied by confidence assessments which take account of the relative scientific certainty of the assessments on a scale of high, medium and low. The level of confidence should be taken into account in considering the possible requirements for management measures. In line with the precautionary principle, a lack of scientific certainty should not, on its own, be a sufficient reason for not taking action.

8.2 Further Considerations

8.5 The preparation of the pressures-features sensitivity matrix represents the first step in the process of assisting MCZ regional projects to consider issues of compatibility during MCZ site selection and in the identification of possible requirements for management measures within sties proposed for MCZ designation.

8.6 To support MCZ Regional Projects in applying the study outputs, this report contains advice on how to use the matrix. For some pressure-feature combinations, it is likely that the MCZ regional projects will need to do further assessment to determine sensitivity at a local level.

8.7 To ensure consistency of approach, it may be appropriate for the statutory agencies (JNCC and Natural England) to provide more specific guidance on the use of the matrix. This guidance might also usefully identify the relationships between the different matrices being produced.

8.8 In applying the matrix, it might also be helpful to establish a process through which new evidence and practical experience could be used to update and improve existing assessments and their confidence. This should include a process for quality assuring new information and updating the matrix in a controlled manner (i.e. version control as part of a wider quality management system).

8.9 More widely the pressures-features sensitivity matrix can provide a resource to support broader conservation and marine spatial planning initiatives. To increase its usefulness, the matrix might be extended to include a wider range of marine features, for example, marine mammals, turtles, birds, fish, cephalopods. It may also be appropriate to take forward work to develop benchmarks where these do not currently exist.

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Annex A. Marine Broadscale Habitats, Habitats and Species for Which Sensitivity was Assessed

Table A.1: Broad-scale habitats

Broad-scale habitat types	EUNIS Level 3 habitat code
High energy intertidal rock	A1.1
Moderate energy intertidal rock	A1.2
Low energy intertidal rock	A1.3
Intertidal coarse sediment	A2.1
Intertidal sand and muddy sand	A2.2
Intertidal mud	A2.3
Intertidal mixed sediments	A2.4
Coastal saltmarshes and saline reedbeds	A2.5
Intertidal sediments dominated by aquatic angiosperms	A2.6
Intertidal biogenic reefs	A2.7
High energy infralittoral rock	A3.1
Moderate energy infralittoral rock	A3.2
Low energy infralittoral rock	A3.3
High energy circalittoral rock	A4.1
Moderate energy circalittoral rock[§]	A4.2
Low energy circalittoral rock[§]	A4.3
Subtidal coarse sediment	A5.1
Subtidal sand	A5.2
Subtidal mud	A5.3
Subtidal mixed sediments	A5.4
Subtidal macrophyte-dominated sediment	A5.5
Subtidal biogenic reefs	A5.6
Deep-sea bed	A6
Deep-sea rock and artificial hard substrata	A6.1
Deep-sea mixed substrata	A6.2
Deep-sea sand	A6.3
Deep-sea muddy sand	A6.4
Deep-sea mud	A6.5
Deep-sea bioherms	A6.6
Raised features of the deep-sea bed	A6.7
Deep-sea trenches and canyons, channels, slope failures and slumps on the continental slope	A6.8
Vents, seeps, hypoxic and anoxic habitats of the deep sea	A6.9

Table A.2: Rare, threatened or declining habitats

Habitats of conservation importance
Blue Mussel beds (including intertidal beds on mixed and sandy sediments)
Burrowed mud
Carbonate reefs
Coatsal saltmarsh
Cold-water coral reefs
Coral carbonate mounds
Coral Gardens
Deep-sea sponge aggregations
Egg wrack beds
Estuarine rocky habitats
File shell beds
Flame shell beds
Fragile sponge & anthozoan communities on subtidal rocky habitats
Intertidal mudflats
Intertidal underboulder communities
Inshore deep mud with burrowing heart urchins
Kelp and seaweed communities on sublittoral sediment
Littoral chalk communities
Maerl beds
Maerl or coarse shell gravel with burrowing sea cucumbers
Horse mussel (*Modiolus modiolus*) beds
Mud habitats in deep water
Musculus discors beds
Northern seafan communities
Saline lagoons
Sea-pen and burrowing megafauna communities
Ostrea edulis beds
Peat and clay exposures
Sabellaria alveolata reefs
Sabellaria spinulosa reefs
Seagrass beds
Seamounts
Serpulid reefs
Shallow tideswept coarse sands with burrowing bivalves
Sheltered muddy gravels
Submarine structures made by leaking gases
Subtidal chalk
Subtidal mixed muddy sediments
Subtidal sands and gravels
Tideswept algal communities
Tide-swept channels

Table A.3: Species

Scientific name	Common name	Taxon group
Anotrichium barbatum	Bearded red seaweed	Algae
Cruoria cruoriaeformis	Red seaweed	Algae
Dermocorynus montagnei	Red seaweed	Algae
Lithothamnion corallioides	Coral maërl	Algae
Padina pavonica	Peacock's tail	Algae
Phymatolithon calcareum	Common maërl	Algae
Alkmaria romijni	Tentacled lagoon-worm	Annelid (worm)
Armandia cirrhosa	Lagoon sandworm	Annelid (worm)
Gobius cobitis	Giant goby	Bony fish
Gobius couchi	Couch's goby	Bony fish
Hippocampus guttulatus	Long snouted seahorse	Bony fish
Hippocampus hippocampus	Short snouted seahorse	Bony fish
Victorella pavida	Trembling sea mat	Bryozoan (seamat)
Arachnanthus sarsi	Burrowing Sea Anemone	Cnidaria
Alcyonium hibernicum	Pink soft coral	Cnidaria
Amphianthus dohrnii	Sea-fan anemone	Cnidaria
Edwardsia timida	Timid burrowing anemone	Cnidaria
Eunicella verrucosa	Pink sea-fan	Cnidaria
Haliclystus auricula	Stalked jellyfish	Cnidaria
Leptopsammia pruvoti	Sunset cup coral	Cnidaria
Lucernariopsis campanulata	Stalked jellyfish	Cnidaria
Lucernariopsis cruxmelitensis	Stalked jellyfish	Cnidaria
Parazoanthus anguicomus	White cluster anemone	Cnidaria
Nematostella vectensis	Starlet sea anemone	Cnidaria
Gammarus insensibilis	Lagoon sand shrimp	Crustacean
Gitanopsis bispinosa	Amphipod shrimp	Crustacean
Mitella pollicipes	Gooseneck barnacle	Crustacean
Palinurus elephas	Spiny lobster	Crustacean
Leptometra celtica	Feather star	Echinoderm
Arctica islandica	Ocean quahog	Mollusc
Atrina fragilis	Fan mussel	Mollusc
Caecum armoricum	Defolin`s lagoon snail	Mollusc
Glossus humanus	Heart cockle	Mollusc
Ostrea edulis	Native oyster	Mollusc
Paludinella littorina	Sea snail	Mollusc
Tenellia adspersa	Lagoon sea slug	Mollusc

Annex B. Pressures- MCZ/MPA Features Sensitivity Matrix

MB0102 Pressures - MCZ/MPA Features Sensitivity Matrix.
Full Version
Version 1.0
31st August 2010

The tabs within this excel file comprise the sensitivity matrix that was developed under Task 3 of Defra Contract MB0102 ' Accessing and developing the required biophysical datasets and data layers for Marine Protected Areas network planning and wider marine spatial planning purposes'. A simplified version of the matrix has also been produced and is available separately.
The assessments are supported by more detailed information contained within feature-specific proformas. These are presented in Annex G to the accompanying report and are available as separate Excel files.
The matrix contributes to JNCC's features-activities tool which will link the sensitivity of MCZ/MPA features to specific activities based on the linkages between the pressures-features and a seperate pressures-activities matrices.

Further advice on the use of the matrix can be obtained from the following members of the Project Steering Group:
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The matrix assesses the sensitivity of 108 features (which have been grouped into Broadscale Habitats (based on EUNIS Classification Level 3), Habitats of Conservation Interest and Species of Conservation Interest) to 40 pressures that can be linked to human activities in the marine environment. Full details of the methodology are provided in an accomapnying project report: Tillin, H.M., Hull, S.C. & Tyler-Walters, H.T.W., 2010. Accessing and developing the required biophysical datasets and data layers for Marine Protected Areas network planning and wider marine spatial planning purposes. Report No 22 Task 3 Development of a Sensitivity Tool (pressures-MXZ/MPA features).

It should be noted that sensitivity is assessed to a pre-determined benchmark for each pressure. An assessment of not sensitive means that the feature is judged to be not sensitive at the pressure benchmark, it does not mean that the feature would be unaffected by the pressure at different levels of intensity, duration, and magnitude to the benchmark.

The sensitivity assessment methodology has involved the following steps:

Step 1 - Block-filling the sensitivity matrix for those pressure x feature combinations where there is no exposure to the pressure;

Step 2 - Undertaking a sensitivity assessment based on a consideration of the resistance and resilience (see scales below) of the feature, to the pressure benchmark;

Step 3 – Assigning a level of confidence to the sensitivity assessment (recorded in pro-formas supplied separately);

Step 4 – providing an audit trail (recording in pro-formas supplied separately).

The matrix records the sensitivity assessment with a letter code and a colour code (see tables below). For some broadscale habitats and habitat FOCI, assessments are presented as a range of sensitivity, reflecting variations in the sensitivity of the constituent biotopes

Worksheet Codes	
NA	Not Assessed
NE	Not Exposed
NS Not	Sensitive
L	Low Sensitivty
M	Medium Sensitivity
H	High Sensitivity
	Broadscale habitat assessment based on the range of sensitivity of constituent biotopes/species
	Multiple and conflicting assessments made for feature/pressure combination.

The sensitivity assessments are based on combined resistance and resilience categories as shown in the table below

	Resistance categories			
Resilience	None	Low	Medium	High
Very Low	High	High	Medium	Low
Low	High	High	Medium	Low
Medium	Medium	Medium	Medium	Low
High	Medium	Low	Low	Not Sensitive

Resistance	**Description**	**Resilience**	**Description**
None	Key functional, structural, characterising species severely decline and/or physico-chemical parameters are also affected e.g. removal of habitat causing change in habitat type.	Very low	Negligible or prolonged recovery possible; at least 25 years to recover structure and function
Low	Significant mortality of key and characterising species with some effects on physico-chemical character of habitat.	Low	Full recovery within 10-25 years
Medium	Some mortality of species (can be significant where these are not keystone structural /functional and characterising species) without change to habitat type.	Medium	Full recovery between 2- 10 years
High	No significant effects to the physico-chemical character of habitat and no effect on population viability of key/characterising species but may affect feeding, respiration and reproduction rates.	High	Full recovery within 2 years

Pressure theme	Climate change							Hydrological changes (inshore/local)					
Pressure / Broadscale Habitats	Atmospheric climate change	pH changes	Temperature changes - regional/ national	Salinity changes - regional/ national	Water flow (tidal&ocean current) changes - regional/ national	Emergence regime changes (sea level) - regional/ national	Wave exposure changes - regional/ national	Temperature changes - local	Salinity changes - local	Water flow (tidal current) changes - local	Emergence regime changes - local	Wave exposure changes - local	Water clarity changes
Pressure Benchmarks	Increases of 3.5-4.6 °C (winter-summer) by 2050s	Mean 0.2 pH decrease by 2050	1.5-4 °C increase by 2100	0.2 psu decrease by 2100	Peak mean spring tide flow change between 0.1m/s to 0.2m/s over an area >1km2 or 50% of width of water body for > 1 year	Increased ASL of 21 cm by 2050 in London	A change in nearshore significant wave height >3% but <5%	A 5 °C change in temp for a one month period, or 2° C for one year	Increase from 35 to 38 units for one year or Decrease in salinity by 4-10 units for a year	Peak mean spring tide flow change between 0.1m/s to 0.2m/s over an area >1km2 or 50% of width of water body for > 1 year	**Intertidal species (and habitats not uniquely defined by intertidal zone)** A 1 hour change in the time covered or not covered by the sea for a period of 1 year. **Habitats and landscapes defined by intertidal zone** An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline.	A change in nearshore significant wave height >3% but <5%	A change in one rank on the WFD scale, e.g. from clear to turbid for one year
High energy intertidal rock	M (L)	NA (L)	M (L)	NS (L)	NS (L)	NS (L)	NS (L)	NS-H (L)	NS-H (L)	NS (L)	NS-M (L)	NS (L)	NS-H (L)
Moderate energy intertidal rock	M (L)	NA (L)	M (L)	NS (L)	NS-M (L)	NS (L)	NS-M (L)	L (L)	NS-L (L)	NS-M (L)	L-M (L)	NS-M (L)	NS (L)
Low energy intertidal rock	M (L)	NA (L)	M (L)	NS (L)	NS-H (L)	NS (L)	NS-H (L)	L-H (L)	NS-L (L)	NS-H (L)	M (L)	NS-H (L)	NS (L)
Intertidal coarse sediment	M (L)	NA (L)	M (L)	NS (L)	NS (L)	NS (L)	NS (L)	L-H (L)	NS-M (L)	NS (L)	NS (L)	NS (L)	NS (L)
Intertidal sand and muddy sand	M (L)	NA (L)	M (L)	NS (L)	NS (L)	H (L)	M (L)	L (L)	L (L)	NS (L)	M (L)	M (L)	NS (L)
Intertidal mud	M (L)	NA (L)	M (L)	NS (L)	NS (L)	H (L)	M (L)	L (H)	L (H)	NS (H)	M (L)	M (L)	NS (L)
Intertidal mixed sediments	M (L)	NA (L)	M (L)	NS (L)	NS (L)	NS (L)	M (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	M (L)
Coastal saltmarshes and saline reedbeds	M (L)	NA (L)	M (L)	NS (L)	NE (L)	M (L)	M (L)	NA (L)	NS (L)	M (L)	M (L)	M (L)	NS (L)
Intertidal sediments dominated by aquatic angiosperms	M (M)	NA (L)	M (M)	NS (L)	NS-M (H)	H (M)	M (L)	NS (M)	NS (M)	NS-M (H)	L-M (M)	M (L)	L-H (L-M)
Intertidal biogenic reefs	M (L)	NA (L)	M (L)	NS (L)	NS-M (L)	L-H (L)	M-H (L)	L-H (L)	NS (L)	NS-M (L)	M (L)	M-H (L)	NS-L (L)
High energy infralittoral rock	NE (L)	NA (L)	M (L)	NS (L)	NS (L)	NE (L)	NS (L)	NA (L)	L-M (L)	NS (L)	NE (L)	NS (L)	L-M (L)
Moderate energy infralittoral rock	NE (L)	NA (L)	M (L)	NS (L)	NS (L)	NE (L)	NS (L)	NA (L)	L-M (L)	NS (L)	NE (L)	NS (L)	L-M (L)
Low energy infralittoral rock	NE (L)	NA (L)	M (L)	NS (L)	NS (L)	NE (L)	NS (L)	NA (L)	L-M (L)	NS (L)	NE (L)	NS (L)	L-H (L)
High energy circalittoral rock	NE (L)	NA (L)	M (L)	NS (L)	NS (L)	NE (L)	NS (L)	NS-H (L)	H (L)	NS (L)	NE (L)	NS (L)	NS-H (L)
Moderate energy circalittoral rock	NE (L)	NA (L)	M (L)	NS (L)	NS (L)	NE (L)	NS-M (L)	NS-H (L)	L-H (L)	NS (L)	NE (L)	NS-M (L)	NS-H (L)
Low energy circalittoral rock	NE (L)	NA (L)	M (L)	NS (L)	NS-L (L)	NE (L)	NS-L (L)	NA (L)	L-M (L)	NS-L (L)	NE (L)	NS-L (L)	M (L)
Subtidal coarse sediment	NE (L)	NA (L)	NS (L)	NS (L)	NS (L)	NE (L)	NS (L)	NS (L)	L-M (L)	NS (L)	NE (L)	NS (L)	NS (L)
Subtidal sand	NE (L)	NA (L)	M (L)	NS (L)	NS-L (L)	NE (L)	NS (L)	NA (L)	L-M (L)	NS-L (L)	NE (L)	NS (L)	NS (L)
Subtidal mud	NE (L)	NA (L)	M (L)	NS (L)	NS-L (L)	NE (L)	NS-L (L)	M (L)	L-M (L)	NS-L (L)	NE (L)	NS-L (L)	NS (L)
Subtidal mixed sediments	NE (L)	NA (L)	M (L)	NS (L)	NS-L (L)	NE (L)	NS-L (L)	M (L)	NS-H (L)	NS-L (L)	NE (L)	NS-L (L)	NS-M (L)
Subtidal macrophyte-dominated sediment	NE (L)	NA (L)	M (L)	NS (L)	NS-M (L)	NE (L)	NS-M (L)	NS-H (M)	NS-H (L)	NS-M (L)	NE (L)	NS-M (L)	L-H (L)
Subtidal biogenic reefs	NE (L)	NA (L)	M (L)	NS (L)	NS-M (L)	NE (L)	NS-H (L)	NS-H (L)	NS-L (L)	NS-M (L)	NE (L)	NS-H (L)	NS-L (L)
Deep-sea bed	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)
Deep-sea rock and artificial hard substrata	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)
Deep-sea mixed substrata	NE (L)	NA (L)	NS (L)	NS (L)	H (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)
Deep-sea sand	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)
Deep-sea muddy sand	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)
Deep-sea mud	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)
Deep-sea bioherms	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)
Raised features of the deep-sea bed	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NS (L)
Deep-sea trenches and canyons, channels, slope failures and slumps on the continental slope	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NE (L)	NE (L)	NE (L)	M (L)	NE (L)	NE (L)	NS (L)
Vents, seeps, hypoxic and anoxic habitats of the deep sea	NE (L)	NA (L)	NA (L)	NA (L)	NA (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)

Pressure theme	Pollution and other chemical change							Physical loss		Physical damage					
Pressure / Broadscale Habitats	Non-synthetic compound contamination (inc. heavy metals, hydrocarbons, produced water)	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Radionuclide contamination	Introduction of other substances (solid, liquid or gas)	De-oxygenation	Nitrogen&phosphorus enrichment	Organic enrichment	Physical change (to another seabed type)	Physical loss (to land or freshwater habitat)	Siltation rate changes (low)	Siltation rate changes (high)	Penetration and/or disturbance of the substrate below the surface of the seabed	Shallow abrasion/penetration: damage to seabed surface and penetration	Surface abrasion: damage to seabed surface features	Physical removal (extraction of substratum)
Pressure Benchmarks	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls	An increase in 10 µGy/h above background level.	None proposed	Compliance with WFD criteria for good status	Compliance with WFD criteria for good status	A deposit of 100gC/m²/yr	Change in 1 folk class for 2 years	Permanent loss of existing saline habitat	5cm of fine material added to the seabed in a single event.	30cm of fine material added to the seabed in a single event.	Structural damage to seabed >25mm	Damage to seabed surface and penetration ≤25mm	Damage to seabed surface features	Extraction of sediment to 30cm
High energy intertidal rock	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M-H (L)	H (L)	NS-L (L)	L (L)	M-H (L)	M-H (L)	M (L)	M-H (L)
Moderate energy intertidal rock	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M-H (L)	H (L)	NS-L (L)	L-H (L)	M-H (L)	M-H (L)	M (L)	M-H (L)
Low energy intertidal rock	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS-H (L)	H (L)	H (L)	NS-H (L)	M-H (L)	M-H (L)	M-H (L)	M-H (L)	M-H (L)
Intertidal coarse sediment	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	L (L)	L (L)	NS (L)	NS (L)	NS (L)	M (L)
Intertidal sand and muddy sand	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (L)	H (L)	M (L)	M (L)	M (L)	L (H)	L (H)	M (L)
Intertidal mud	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (H)	H (L)	H (L)	NS (H)	L (H)	L (H)	L (H)	NS (H)	M-H (H)
Intertidal mixed sediments	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	M (L)	H (L)	M-H (L)	M-H (L)	M (L)	H (L)
Coastal saltmarshes and saline reedbeds	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	H (L)	H (H)	L (M)	M (M)	M (M)	M (M)	M (M)	H (H)
Intertidal sediments dominated by aquatic angiosperms	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	M (M)	NS-M (M)	NS-M (M)	H (H)	L-H (L)	M-H (L)	H (M)	H (H)	L-M (L-M)	H (M)
Intertidal biogenic reefs	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	NS-H (L)	H (L)	NS-L (L)	L-H (L)	M-H (L)	M-H (L)	L-M (L)	M-H (L)
High energy infralittoral rock	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (L)	H (L)	NS (L)	M-H (L)	M (L)	M (L)	M (L)	M (L)
Moderate energy infralittoral rock	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NS (L)	M-H (L)	M-H (L)	M (L)	M (L)	M (L)
Low energy infralittoral rock	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M-H (L)	H (L)	L (L)	M-H (L)	M-H (L)	M-H (L)	M (L)	M (L)
High energy circalittoral rock	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M-H (L)	H (L)	M-H (L)	M-H (L)	M-H (L)	M-H (L)	M-H (L)	M-H (L)
Moderate energy circalittoral rock	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M-H (L)	H (L)	NS-H (L)	M-H (L)	M-H (L)	M-H (L)	L-H (L)	M-H (L)
Low energy circalittoral rock	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NS-M (L)	M (L)	M (L)	M (L)	M (L)	M (L)
Subtidal coarse sediment	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NS-M (L)	NS-M (L)	L-M (L)	L-M (L)	NS-H (L)	L-H (L)
Subtidal sand	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (H)	H (L)	H (L)	M (L)	H (L)	L-M (L-M)	NS-M (L)	NS-M (L)	L-H (M)
Subtidal mud	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS-H (L)	M (L)	H (L)	NS-L (L)	M (L)	M (L)	M (L)	L-M (L)	M (L)
Subtidal mixed sediments	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (L)	H (L)	NS (L)	M (L)	H (L)	H (L)	M (L)	H (L)
Subtidal macrophyte-dominated sediment	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS-M (L)	M-H (L)	H (L)	NS-H (L)	M-H (L)	M-H (L)	L-H (L)	L-H (L)	M-H (L)
Subtidal biogenic reefs	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M-H (L)	H (L)	NS-M (L)	L-H (L)	M-H (L)	M-H (L)	L-M (L)	M-H (L)
Deep-sea bed	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS-H (L)	H (L)	NE (L)	L-H (L)	L-H (L)	H (L)	H (L)	H (L)	H (L)
Deep-sea rock and artificial hard substrata	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS-H (L)	H (L)	NE (L)	L-H (L)	L-H (L)	H (L)	H (L)	H (L)	H (L)
Deep-sea mixed substrata	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (L)	H (L)	NE (L)	L-H (L)	L-H (L)	H (L)	H (L)	H (L)	H (L)
Deep-sea sand	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (L)	H (L)	NE (L)	L-H (L)	L-H (L)	H (L)	H (L)	H (L)	H (L)
Deep-sea muddy sand	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (L)	H (L)	NE (L)	L-H (L)	L-H (L)	H (L)	H (L)	H (L)	H (L)
Deep-sea mud	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (M)	H (L)	NE (L)	H (L)	H (L)	H (M)	H (M)	NS-H (M-H)	H (M)
Deep-sea bioherms	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (L)	H (H)	NE (L)	H (L)	H (L)	H (H)	H (H)	H (H)	H (H)
Raised features of the deep-sea bed	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS-H (L)	H (L)	NE (L)	H (L)	H (L)	H (L)	H (L)	H (L)	H (L)
Deep-sea trenches and canyons, channels, slope failures and slumps on the continental slope	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (M)	H (L)	NE (L)	L-H (L)	L-H (L)	H (M)	H (H)	H (H)	H (L)
Vents, seeps, hypoxic and anoxic habitats of the deep sea	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NA (L)	NA (L)	NE (L)	NA (L)	NA (L)	NA (L)	NA (L)	NA (L)	NA (L)

Pressure theme	Other physical pressures							Biological pressures				
Pressure / Broadscale Habitats	Electromagnetic changes	Litter	Introduction of light	Underwater noise	Barrier to species movement	Death or injury by collision	Visual disturbance	Genetic modification& translocation of indigenous species	Introduction of microbial pathogens	Introduction or spread of non-indigenous species	Removal of target species	Removal of non-target species
Pressure Benchmarks	Local electric field of 1V m-1. Local magnetic field of 10µT.	None proposed	None proposed	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.	0.1% of tidal volume on average tide, passing through artificial structure	None proposed	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives	The introduction of microbial pathogens *Bonamia* and *Marteilia refringens* to an area where they are currently not present.	A significant pathway exists for introduction of one or more invasive non-indigenous species (INS) ; creation of new colonization space >1ha. One or more INS in Table C3 (Technical Report) has been recorded in the relevant habitat	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	Removal of features through pursuit of a target fishery at a commercial scale.
High energy intertidal rock	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS-M (L)	NS-H (L)	M (L)	NS (L)
Moderate energy intertidal rock	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS-M (L)	L-M (L)	M (L)	NS (L)
Low energy intertidal rock	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS-M (L)	L-M (L)	M (L)	NS (L)
Intertidal coarse sediment	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS (L)	NE (H)	NE (H)
Intertidal sand and muddy sand	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS-M (L)	NS-M (L)	NS-M (L)
Intertidal mud	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS-M (L-H)	NS-M (L-H)	M (M)
Intertidal mixed sediments	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	M (L)	L-M (L)	M (L)
Coastal saltmarshes and saline reedbeds	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	M (M)	L (M)	NE (H)
Intertidal sediments dominated by aquatic angiosperms	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	M-H (L)	NS (H)	H (H)
Intertidal biogenic reefs	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS-M (L)	NS-M (M)	M-H (M)
High energy infralittoral rock	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS-L (L)	M (M)	M (L)
Moderate energy infralittoral rock	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	M (L)	M (M)	M (L)
Low energy infralittoral rock	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS-M (L)	M-H (M)	M (L)
High energy circalittoral rock	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS-M (L)	M (M)	M (L)
Moderate energy circalittoral rock	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	L-M (L)	NS-M (H)	M-H (M)
Low energy circalittoral rock	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS-M (L)	NS (L)	L-H (L)
Subtidal coarse sediment	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS-M (L)	NS (L)	NS-M (L)
Subtidal sand	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS-M (L)	NS (L)	NS-M (H)
Subtidal mud	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS-M (L)	NS-M (L-H)	M (L-H)
Subtidal mixed sediments	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS-H (L)	L-M (M)	L (M)	M (M)
Subtidal macrophyte-dominated sediment	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	M-H (L)	NS-H (L)	NS-H (L)
Subtidal biogenic reefs	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS-H (L)	NS-H (M)	NS-H (L)
Deep-sea bed	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS-M (L)	NS-H (L)	NS-H (L)
Deep-sea rock and artificial hard substrata	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NE (L)	NS (L)	NS (L)
Deep-sea mixed substrata	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NE (L)	NS (L)	H (L)
Deep-sea sand	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NE (L)	NS (L)	H (L)
Deep-sea muddy sand	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (L)
Deep-sea mud	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NE (L)	L (L)	H (H)
Deep-sea bioherms	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NE (L)	NS (L)	H (H)
Raised features of the deep-sea bed	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NE (L)	NS (L)	H (L)
Deep-sea trenches and canyons, channels, slope failures and slumps on the continental slope	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NE (L)	L-M (H)	L-M (H)
Vents, seeps, hypoxic and anoxic habitats of the deep sea	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NA (L)	NS (L)	NE (L)	NA (L)	NA (L)

Pressure theme	Climate change							Hydrological changes (inshore/local)					
Pressure	Atmospheric climate change	pH changes	Temperature changes - regional/national	Salinity changes - regional/national	Water flow (tidal&ocean current) changes - regional/national	Emergence regime changes (sea level) - regional/national	Wave exposure changes - regional/national	Temperature changes - local	Salinity changes - local	Water flow (tidal current) changes - local	Emergence regime changes - local	Wave exposure changes - local	Water clarity changes
Habitats / Pressure Benchmarks	Increases of 3.5-4.6 °C (winter-summer) by 2050s	Mean 0.2 pH decrease by 2050	3.5-4 °C increase by 2100	0.2 psu decrease by 2100	Peak mean spring tide flow change between 0.1m/s to 0.2m/s over an area >1km2 or 50% of width of water body for > 1 year	Increased ASL of 21 cm by 2050 in London	A change in nearshore significant wave height >3% but <5%	A 5 °C change in temp for a one month period, or 2°C for one year	Increase from 35 to 38 units for one year or Decrease in salinity by 4-10 units for a year	Peak mean spring tide flow change between 0.1m/s to 0.2m/s over an area >1km2 or 50% of width of water body for > 1 year	**Intertidal species (and habitats not uniquely defined by intertidal zone)** A 1 hour change in the time covered or not covered by the sea for a period of 1 year. **Habitats and landscapes defined by intertidal zone** An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline.	A change in nearshore significant wave height >3% but <5%	A change in one rank on the WFD scale, e.g. from clear to turbid for one year
Blue Mussel beds (including intertidal beds on mixed and sandy sediments)	M (L)	NA (L)	M (L)	NS (L)	NS (L)	L (L)	M (L)	L (L)	NS (L)	NS (L)	M (L)	M (L)	L (L)
Burrowed mud	NE (L)	NA (L)	M (L)	NS (L)	NS (L)	NE (L)	NS (L)	M (L)	L (L)	NS (L)	NE (L)	NS (L)	NS (L)
Carbonate reefs	NE (L)	NA (L)	NS (L)	NS (L)	NS (L)	NE (L)	NS (L)	NS (L)	NS (L)	NS (L)	NE (L)	NS (L)	NS (L)
Coastal saltmarsh	M (L)	NA (L)	M (L)	NS (L)	M (L)	M (L)	M (L)	NA (L)	NS (L)	M (L)	M (L)	M (L)	NS (L)
Cold-water coral reefs	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NE (L)	H (L-H)	H (H)	H (M)	NE (L)	NE (L)	NS (L)
Coral carbonate mounds	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NE (L)	H (L)	H (L)	H (L)	NE (L)	NE (L)	NS (L)
Coral Gardens	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NE (L)	H (L)	H (L)	H (L)	NE (L)	NE (L)	NS (L)
Deep-sea sponge aggregations	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NE (L)	H (H)	H (H)	NE (L)	NE (L)	NE (L)	NS (L)
Egg wrack beds	M (L)	NA (L)	M (L)	NS (L)	H (L)	NS (L)	H (L)	NS (L)	L (L)	H (L)	M (L)	H (L)	NS (L)
Estuarine rocky habitats	M (L)	NA (L)	M (L)	NS (L)	NS (L)	H (L)	NS (M)	L (M)	L (L)	NS (L)	M (L)	NS (L)	NS (L)
File/Flame shell beds	NE (L)	NA (L)	M (L)	NS (L)	L (L)	NE (L)	NE (L)	NS (L)	M (L)	L (L)	NE (L)	NE (L)	NS (L)
Fragile sponge&anthozoan communities on subtidal rocky habitats	NE (L)	NA (L)	M (L)	NS (L)	M (L)	NE (L)	M (L)	M (L)	H (L)	M (L)	NE (L)	M (L)	NS (L)
Intertidal mudflats	M (L)	NA (L)	M (L)	NS (L)	NS (L)	H (L)	M (L)	L (H)	L (H)	NS (H)	M (L)	M (L)	NS (L)
Intertidal under boulder communities	NS (L)	NA (L)	M (L)	NS (L)	NS (L)	M (L)	NS (L)	L (L)	L (L)	L (L)	L (L)	NS (L)	NA (L)
Inshore deep mud with burrowing heart urchins	NE (L)	NA (L)	M (L)	NS (L)	NS (L)	NE (L)	NS (L)	M (L)	NA (L)	NS (L)	NE (L)	NS (L)	NS (L)
Kelp and seaweed communities on sublittoral sediment	NE (L)	NA (L)	M (L)	NS (L)	NS (H)	NS (L)	NS (H)	L (M)	NS (L)	NS (H)	L (L)	NS (H)	L (L)
Littoral chalk communities	M (L)	NA (L)	M (L)	NS (L)	NS (L)	H (L)	NS (L)	M (L)	L (L)	NS (L)	L (L)	NS (L)	H (L)
Maerl beds	M (L)	NA (L)	M (L)	NS (L)	NS (L)	NS (L)	NS (L)	H (L)	H (M)	NS (L)	NS (L)	NS (L)	H (L)
Maerl or coarse shell gravel with burrowing sea cucumbers	M (L)	NA (L)	M (L)	NS (L)	NS (M)	NS (L)	NS (L)	H (L)	H (M)	NS (L)	NE (L)	NS (L)	H (L)
Horse mussel (Modiolus modiolus) beds	NE (L)	NA (L)	M (L)	NS (L)	M (L)	NE (L)	M (L)	H (L)	L (M)	M (L)	NE (L)	M (L)	NS (L)
Mud habitats in deep water	NE (L)	NA (L)	M (L)	NS (L)	NE (L)	NE (L)	NE (L)	NE (L)	NA (L)	NE (L)	NE (L)	NE (L)	NE (L)
Musculus discors beds	NE (L)	NA (L)	M (L)	NS (L)	M (L)	NE (L)	NE (L)	NS (L)	M (L)	M (L)	NE (L)	NE (L)	H (L)
Northern sea fan communities	NE (L)	NA (L)	H (L)	NS (L)	NS (H)	NE (L)	NE (H)	H (L)	NA (L)	NS (H)	NE (L)	NE (H)	NS (L)
Saline lagoons	NE (L)	NA (L)	M (L)	NS (L)	NE (L)	H (L)	NE (L)	NS (M)	L (M)	NE (L)	NE (L)	NE (L)	M (L)
Sea-pen and burrowing megafauna communities	NE (L)	NA (L)	M (L)	NS (L)	NS (L)	NE (L)	NS (L)	M (L)	M (L)	NS (L)	NE (L)	NS (L)	NS (L)
Ostrea edulis beds	M (L)	NA (L)	M (L)	NS (L)	NS (L)	M (L)	L (L)	M (L)	H (L)	NS (L)	NS (L)	L (L)	NS (L)
Peat and clay exposures	M (L)	NA (L)	M (L)	NS (L)	NS (L)	H (L)	L (L)	NA (L)	NS (L)	NS (L)	L (L)	L (L)	NS (L)
Sabellaria alveolata reefs	M (L)	NA (L)	M (L)	NS (L)	NS (L)	M (L)	H (L)	H (M)	NS (L)	M (L)	M (L)	H (L)	NS (L)
Sabellaria spinulosa reefs	NE (L)	NA (L)	M (L)	NS (L)	NS (L)	L (L)	NS (L)	NS (L)	L (L)	L (L)	NE (L)	NS (L)	NS (L)
Seagrass beds	M (M)	NA (L)	M (M)	NS (L)	NS-M (H)	H (M)	M (L)	NS (M)	NS (M)	NS-M (H)	L-M (M)	M (L)	L-H (L-M)
Seamounts	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NE (L)	H (L)	H (L)	H (L)	NE (L)	NE (L)	NS (L)
Serpulid reefs	NE (L)	NA (L)	M (L)	NS (L)	H (L)	NE (L)	NA (L)	NS (L)	H (L)	H (L)	NE (L)	NE (L)	NS (L)
Shallow tide swept coarse sands with burrowing bivalves	NE (L)	NA (L)	L (L)	NS (L)	NS (L)	NS (L)	NS (L)	L (L)	L (L)	NS (L)	NS (L)	NS (L)	NS (M)
Sheltered muddy gravels	M (L)	NA (L)	M (L)	NS (L)	NS (L)	NS (L)	M (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	M (L)
Submarine structures made by leaking gases	NE (L)	NA (L)	M (L)	NS (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)
Subtidal chalk	NE (L)	NA (L)	M (L)	NS (L)	NS (M)	NE (L)	NS (M)	M (L)	NS (M)	NS (M)	NE (L)	NS (M)	NS-M (M)
Subtidal mixed muddy sediments	NE (L)	NA (L)	M (L)	NS (L)	NS (L)	NE (L)	NS-L (L)	M (L)	NS-H (L)	NS (L)	NE (L)	NS-L (L)	NS-L (L)
Subtidal sands and gravels	NE (L)	NA (L)	NS (L)	NS (L)	NS (M)	NE (L)	NS (H)	NS (L)	L (L)	NS (M)	NE (L)	NS (H)	NS (H)
Tide swept algal communities	M (L)	NA (L)	M (L)	NS (L)	L (L)	NS (L)	L (L)	L (L)	L (L)	L (L)	L (L)	L (L)	L (H)
Tide-swept channels	M (L)	NA (L)	M (L)	NS (L)	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	NS (L)	NS (L)

Pressure theme	Pollution and other chemical changes							Physical loss		Physical damage					
Pressure	Non-synthetic compound contamination (inc. heavy metals, hydrocarbons, produced water)	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Radionuclide contamination	Introduction of other substances (solid, liquid or gas)	De-oxygenation	Nitrogen&phosphorus enrichment	Organic enrichment	Physical change (to another seabed type)	Physical loss (to land or freshwater habitat)	Siltation rate changes (low)	Siltation rate changes (high)	Penetration and/or disturbance of the substrate below the surface of the seabed	Shallow abrasion/penetration: damage to seabed surface and penetration	Surface abrasion: damage to seabed surface features	Physical removal (extraction of substratum)
Habitats / Pressure Benchmarks	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls	An increase in 10 µGy/h above background level.	None proposed	Compliance with WFD criteria for good status	Compliance with WFD criteria for good status	A deposit of 100gC/m²/yr	Change in 1 folk class for 2 years	Permanent loss of existing saline habitat	5cm of fine material added to the seabed in a single event.	30cm of fine material added to the seabed in a single event.	Structural damage to seabed >25mm	Damage to seabed surface and penetration ≤25mm	Damage to seabed surface features	Extraction of sediment to 30cm
Blue Mussel beds (including intertidal beds on mixed and sandy sediments)	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	M (M)	H (L)	L (M)	H (L)	M (L)	M (L)	M (L)	M (L)
Burrowed mud	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NS (M)	M (M)	M (L)	M (M)	M (M)	M (H)
Carbonate reefs	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	No Evid. (L)	H (L)	NS (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)
Coastal saltmarsh	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	H (L)	H (H)	L (M)	M (M)	M (M)	M (M)	M (M)	H (H)
Cold-water coral reefs	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (L)	H (H)	H (L)	H (H)	H (H)	H (H)	H (H)	H (H)	H (H)
Coral carbonate mounds	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (L)	H (H)	H (L)	H (L)	H (L)	H (L)	H (H)	H (H)	H (H)
Coral Gardens	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (L)	H (H)	H (L)	H (L)	H (L)	H (L)	H (H)	H (H)	H (H)
Deep-sea sponge aggregations	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (L)	H (H)	NE (L)	H (H)	H (H)	H (H)	H (H)	H (H)	H (H)
Egg wrack beds	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (L)	H (H)	H (H)	H (L)	H (L)	H (H)	NE (L)	NS (M)	H (H)
Estuarine rocky habitats	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (H)	M (L)	H (L)	NS (L-H)	L (L)	M (L)	M (L)	NS (L)	NE (L)
File/Flame shell beds	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (H)	H (L)	H (L)	H (L)	H (M)	H (M)	M (M)	H (M)
Fragile sponge&anthozoan communities on subtidal rocky habitats	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (L)	H (L)	H (L)	H (L)	H (L)	H (L)	H (L-H)	H (L)
Intertidal mudflats	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (H)	H (L)	H (L)	NS (H)	L (H)	L (H)	L (H)	L (H)	M (H)
Intertidal under boulder communities	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	M (L)	H (L)	L (L)	M (L)	H (L)	M (L)	M (L)	NE (L)
Inshore deep mud with burrowing heart urchins	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NS (L)	M (L)	M (L)	L (L)	L (L)	M (L)
Kelp and seaweed communities on sublittoral sediment	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NS (L)	M (L)	M (L)	L (L)	L (L)	M (M)
Littoral chalk communities	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (L)	H (L)	NS (L)	NS (L)	M (L)	M (L)	NS (L)	M (L)
Maerl beds	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NA (L)	H (L)	H (H)	H (L)	H (L)	H (M-H)	H (M)	H (L)	H (M)
Maerl or coarse shell gravel with burrowing sea cucumbers	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NA (L)	H (L)	H (H)	H (M)	H (L)	H (M-H)	H (M)	H (L)	H (M)
Horse mussel (Modiolus modiolus) beds	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	H (H)	H (L)	M (L-M)	H (M)	H (M)	H (M)	M (M)	H (M)
Mud habitats in deep water	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (M)	H (L)	NE (L)	H (L)	H (L)	H (M)	H (M)	NS (M)	H (M)
Musculus discors beds	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	H (L)	(H) (L)	H (L)	H (L)	H (L)	M (L)	H (L)
Northern sea fan communities	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	M (M)	H (L)	M (L)	M (M)	M (M)	M (M)	M (M)	M (M)
Saline lagoons	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	M (L)	H (M)	H (L)	M (L)	H (L)	M (L)	M (L)	M (L)	H (M)
Sea-pen and burrowing megafauna communities	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (M)	M (L)	H (L)	L (M)	M (L)	M (L)	M (L)	M (L)	M (L)
Ostrea edulis beds	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	H (H)	H (L)	H (L)	H (L)	H (M)	H (M)	M (M)	H (M)
Peat and clay exposures	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	H (H)	H (H)	NS (H)	L (M)	L (M)	NS (H)	NS (H)	L (M)
Sabellaria alveolata reefs	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (L)	H (L)	NS (L)	L (L)	H (L)	H (L)	L (H)	H (L)
Sabellaria spinulosa reefs	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (L)	H (L)	NS (M)	M (L)	H (L)	H (M)	L (M)	H (L)
Seagrass beds	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	M (M)	NS-M (M)	M (L)	H (H)	L-H (L)	M-H (L)	H (L-H)	H (H)	L-M (L-M)	H (L-H)
Seamounts	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (H)	NE (L)	H (M)	H (M)	H (M)	H (M)	H (M)	H (M)
Serpulid reefs	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NA (L)	H (L)	H (L)	L (M)	M (M)	M (M)	H (M)	M (M)	H (M)
Shallow tide swept coarse sands with burrowing bivalves	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	M (L)	H (L)	NS (M)	L (M)	L (M)	L (M)	L (M)	M (M)
Sheltered muddy gravels	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	M (L)	H (L)	M (M)	H (M)	M (M)	M (M)	M (M)	H (L)
Submarine structures made by leaking gases	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	No Evid. (L)	H (H)	NS (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)
Subtidal chalk	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	L (L)	H (H)	H (H)	L (H)	M (L)	M (M)	L (L)	L (L)	M (M)
Subtidal mixed muddy sediments	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (L)	H (L)	NS (L)	M (L)	H (L)	H (L)	M (L)	H (L)
Subtidal sands and gravels	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (H)	M (H)	H (L)	NS-M (M-H)	NS-M (M-H)	L-M (M-H)	L-M (H)	NS-H (M-H)	M (H)
Tide swept algal communities	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	M (L)	L (L)	H (L)	NS (H)	NS (H)	M (H)	M (H)	L (H)	M (H)
Tide-swept channels	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (H)	H (H)	H (H)	NS (H)	L (L)	H (M)	M (M)	M (M)	H (M)

Pressure theme	Other physical pressures						Biological pressures					
Pressure	Electromagnetic changes	Litter	Introduction of light	Underwater noise	Barrier to species movement	Death or injury by collision	Visual disturbance	Genetic modification&translocation of indigenous species	Introduction of microbial pathogens	Introduction or spread of non-indigenous species	Removal of target species	Removal of non-target species
Habitats / Pressure Benchmarks	Local electric field of 1V m-1. Local magnetic field of 10µT.	None proposed	None proposed	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site	10% change in tidal excursion, or temporary barrier to species movement over ≥50% of water body width.	0.1% of tidal volume on average tide, passing through artificial structure	None proposed	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives	The introduction of microbial pathogens *Bonamia* and *Marteilia refringens* to an area where they are currently not present	A significant pathway exists for introduction of one or more invasive non-indigenous species (NIS) ; creation of new colonization space (<1ha. One or more INS in Table C3 (Technical Report) has been recorded in the relevant habitat	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale	Removal of features through pursuit of a target fishery at a commercial scale.
Blue Mussel beds (including intertidal beds on mixed and sandy sediments)	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (L)	M (H)	M (H)
Burrowed mud	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (L)	M (H)	M (H)
Carbonate reefs	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NS (L)	NS (L)	M (L)
Coastal saltmarsh	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (M)	L (M)	NE (L)
Cold-water coral reefs	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NE (L)	NS (L)	H (H)
Coral carbonate mounds	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NE (L)	NS (L)	H (H)
Coral Gardens	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NE (L)	NS (L)	H (H)
Deep-sea sponge aggregations	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NE (L)	NS (L)	H (H)
Egg wrack beds	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (H)	NS (H)	NS (L)
Estuarine rocky habitats	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	M (L)	H (L)	L (L)	NS (L)
File/Flame shell beds	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	H (L)	NS (L)	H (L)
Fragile sponge&anthozoan communities on subtidal rocky habitats	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M-H (L)	NS (L)	H (L)
Intertidal mudflats	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (H)	M (H)	M (M)
Intertidal under boulder communities	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (L)	M (L)	NS (L)
Inshore deep mud with burrowing heart urchins	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NS (L)	NS (L)	M (L)
Kelp and seaweed communities on sublittoral sediment	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (H)	NS (L)	NS (L)
Littoral chalk communities	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (L)	M (L)	NS (L)
Maerl beds	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	H (L)	H (L)	H (L)
Maerl or coarse shell gravel with burrowing sea cucumbers	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	H (L)	H (L)	H (L)
Horse mussel (Modiolus modiolus) beds	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	H (L)	H (H)	H (L)
Mud habitats in deep water	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NE (L)	L (L)	H (H)
Musculus discors beds	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (L)	NS (L)	M (L)
Northern sea fan communities	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (L)	NS (L)	M (M)
Saline lagoons	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (L)	NS (L)	M (L)
Sea-pen and burrowing megafauna communities	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NS (L)	M (L)	M (L)
Ostrea edulis beds	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	H (L)	H (L)	M (L)	NS (L)
Peat and clay exposures	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NS (L)	NS (L)	L (L)
Sabellaria alveolata reefs	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NS (L)	NS (L)	H (M)
Sabellaria spinulosa reefs	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NS (L)	NS (L)	H (M)
Seagrass beds	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M-H (L-M)	NS (H)	H (H)
Seamounts	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NE (L)	NS (L)	H (H)
Serpulid reefs	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (L)	NE (L)	M (L)
Shallow tide swept coarse sands with burrowing bivalves	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NS (L)	NS (M)	L (L)
Sheltered muddy gravels	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (L)	M (M)	M (M)
Submarine structures made by leaking gases	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NS (L)	NS (L)	M (L)
Subtidal chalk	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (L)	NS (M)	L (M)
Subtidal mixed muddy sediments	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (L)	L (M)	M (M)
Subtidal sands and gravels	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	NS-M (L)	NS-M (L)	NS-M (L-M)
Tide swept algal communities	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (H)	L (H)	L (L)
Tide-swept channels	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (L)	NS (L)	M (L)

Pressure theme	Climate change							Hydrological changes (inshore/local)					
Pressure / Species	Atmospheric climate change	pH changes	Temperature changes - regional/ national	Salinity changes - regional/ national	Water flow (tidal&ocean current) changes - regional/ national	Emergence regime changes (sea level) - regional/ national	Wave exposure changes - regional/ national	Temperature changes - local	Salinity changes - local	Water flow (tidal current) changes - local	Emergence regime changes - local	Wave exposure changes - local	Water clarity changes
Pressure Benchmarks	Increases of 3.5-4.6 °C (winter-summer) by 2050s	Mean 0.2 pH decrease by 2050	1.5-4 °C increase by 2100	0.2 psu decrease by 2100	Peak mean spring tide flow change between 0.1m/s to 0.2m/s over an area >1km2 or 50% of width of water body for > 1 year	Increased ASL of 21 cm by 2050 in London	A change in nearshore significant wave height >3% but <5%.	A 5 °C change in temp for a one month period, or 2° C for one year	Increase from 35 to 38 units for one year or Decrease in salinity by 4-10 units for a year	Peak mean spring tide flow change between 0.1m/s to 0.2m/s over an area >1km2 or 50% of width of water body for > 1 year	**Intertidal species (and habitats not uniquely defined by intertidal zone)** A 1 hour change in the time covered or not covered by the sea for a period of 1 year.**Habitats and landscapes defined by intertidal zone** An increase in relative sea level or decrease in high water level of 1 mm for one year	A change in nearshore significant wave height >3% but <5%	A change in one rank on the WFD scale, e.g. from clear to turbid for one year
Anotrichium barbatum	M (L)	NA (L)	No Evid. (L)	NS (L)	M (L)	No Evid. (L)	M (L)	NS (M)	H (L)	M (L)	No Evid. (L)	M (L)	M (L)
Cruoria cruoriaeformis	M (L)	NA (L)	M (L)	NS (L)	NS (L)	NS (L)	NS (L)	H (L)	H (M)	NS (L)	NS (L)	NS (L)	H (L)
Dermocorynus montagnei	NE (L)	NA (L)	NA (L)	NS (L)	NS (L)	NE (L)	NS (L)	H (L)	H (L)	NS (L)	NS (L)	NS (L)	M (L)
Lithothamnion corallioides	M (L)	NA (L)	M (L)	NS (L)	NS (L)	NS (L)	NS (L)	H (L)	H (M)	NS (L)	NS (L)	NS (L)	H (L)
Padina pavonica	M (L)	NA (L)	NS (L)	M (L)	M (L)	NS (L)	NA (L)	NS (M)	H (L)	M (L)	H (L)	H (M)	H (L)
Phymatolithon calcareum	M (L)	NA (L)	M (L)	NS (L)	NS (L)	NS (L)	NS (L)	H (L)	H (M)	NS (L)	NS (L)	NS (L)	H (L)
Alkmaria romijni	NE (L)	NA (L)	No Evid. (L)	NS (L)	NS (L)	NE (L)	H (L)	NS (L)	L (L)	H (L)	NE (L)	H (L)	M (L)
Armandia cirrhosa	NE (L)	NA (L)	No Evid. (L)	NS (L)	H (L)	NE (L)	NS (L)	No Evid. (L)	H (L)	H (L)	No Evid. (L)	H (L)	NS (L)
Gobius cobitis	M (L)	NA (L)	No Evid. (L)	NS (L)	NS (L)	NS (L)	NS (L)	L (M)	L (L)	NS (L)	NS (L)	NS (L)	L (L)
Gobius couchi	M (L)	NA (L)	No Evid. (L)	NS (L)	NS (L)	NS (L)	NS (L)	L (M)	L (L)	NS (L)	NS (L)	NS (L)	L (L)
Hippocampus guttulatus	NE (L)	NA (L)	M (L)	NS (L)	M (L)	NE (L)	M (L)	M (L)	No Evid. (L)	M (L)	NE (L)	M (L)	NS (L)
Hippocampus hippocampus	NE (L)	NA (L)	M (L)	NS (L)	M (L)	NE (L)	M (L)	M (L)	No Evid. (L)	M (L)	NE (L)	M (L)	NS (L)
Victorella pavida	NE (L)	NA (L)	No Evid. (L)	NS (L)	NE (L)	NE (L)	NE (L)	No Evid. (L)	NS (L)	NE (L)	NE (L)	NE (L)	No Evid. (L)
Arachnanthus sarsi	NE (L)	NA (L)	NA (L)	NS (L)	H (L)	NE (L)	NS (L)	M (L)	NE (L)	H (L)	NE (L)	NS (L)	M (L)
Alcyonium hibernicum	NE (L)	NA (L)	NA (L)	NS (L)	M (L)	NE (L)	M (L)	NS (L)	NE (L)	M (L)	NE (L)	M (L)	M (L)
Amphianthus dohrnii	NE (L)	NA (L)	H (L)	NS (L)	NS (L)	NE (L)	NE (L)	H (L)	L (L)	NS (L)	NE (L)	NE (L)	NS (L)
Edwardsia timida	M (L)	NA (L)	NA (L)	NS (L)	M (L)	NE (L)	NA (L)	L (L)	NA (L)	M (L)	M (L)	NA (L)	M (L)
Eunicella verrucosa	NE (L)	NA (L)	No Evid. (L)	NS (L)	NS (L)	NE (L)	NS (L)	NS (M)	NE (L)	NS (L)	NE (L)	NS (L)	H (L)
Haliclystus auricula	M (L)	NA (L)	M (L)	NS (L)	L (L)	H (L)	M (L)	L (L)	NS (L)	L (L)	M (L)	M (L)	M (L)
Leptopsammia pruvoti	NE (L)	NA (L)	NA (L)	NS (L)	NS (L)	NE (L)	NS (M)	H (M)	H (M)	NS (M)	NE (L)	NS (M)	NS (M)
Lucernariopsis campanulata	M (L)	NA (L)	M (L)	NS (L)	L (L)	H (L)	M (L)	L (L)	NS (L)	L (L)	M (L)	M (L)	M (L)
Lucernariopsis cruxmelitensis	NE (L)	NA (L)	M (L)	NS (L)	NS (L)	NS (L)	NS (L)	L (L)	NS (L)	NS (L)	L (L)	NS (L)	L (L)
Parazoanthus anguicomus	NE (L)	NA (L)	No Evid. (L)	NS (L)	No Evid. (L)	NE (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	NE (L)	No Evid. (L)	No Evid. (L)
Nematostella vectensis	NE (L)	NA (L)	No Evid. (L)	NS (L)	NS (L)	NE (L)	NS (L)	M (L)	L (L)	NS (L)	NE (L)	NS (L)	NS (L)
Gammarus insensibilis	NE (L)	NA (L)	L (L)	NS (L)	NE (L)	NE (L)	NE (L)	L (L)	L (L)	NE (L)	NE (L)	NE (L)	H (L)
Gitanopsis bispinosa	NE (L)	NA (L)	No Evid. (L)	NS (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)
Mitella pollicipes	M (L)	NA (L)	NS (L)	NS (L)	NS (L)	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)
Palinurus elephas	NE (L)	NA (L)	NS (M)	NS (L)	NS (L)	NE (L)	NS (L)	NS (M)	H (L)	NS (L)	NE (L)	NS (L)	No Evid. (L)
Leptometra celtica	NE (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)	NE (L)
Arctica islandica	NE (L)	NA (L)	NA (L)	NS (L)	L (L)	NE (L)	NE (L)	H (L)	NS (L)	L (L)	NE (L)	M (L)	NE (L)
Atrina pectinata	NE (L)	NA (L)	NA (L)	NS (L)	L (L)	NE (L)	L (L)	L (L)	NA (L)	L (L)	NE (L)	L (L)	M (L)
Caecum armoricum	NE (L)	NA (L)	No Evid. (L)	NS (L)	H (L)	NE (L)	No Evid. (L)	No Evid. (L)	H (L)	H (L)	NE (L)	No Evid. (L)	H (L)
Glossus humanus	NE (L)	NA (L)	No Evid. (L)	NS (L)	L (L)	NE (L)	L (L)	No Evid. (L)	NS (L)	L (L)	NE (L)	L (L)	M (L)
Ostrea edulis	M (L)	NA (L)	NS (M)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	L (L)	NS (L)	M (L)	M (L)	NS (L)
Paludinella littorina	M (L)	NA (L)	NA (L)	NS (L)	NS (L)	NA (L)	H (L)	M (L)	L (L)	NS (L)	L (L)	H (L)	NA (L)
Tenellia adspersa	M (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (L)	NA (L)	NS (L)

Pressure theme	Pollution and other chemical changes							Physical loss		Physical damage					
Pressure / Species	Non-synthetic compound contamination (inc. heavy metals, hydrocarbons, produced water)	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Radionuclide contamination	Introduction of other substances (solid, liquid or gas)	De-oxygenation	Nitrogen&phosphorus enrichment	Organic enrichment	Physical change (to another seabed type)	Physical loss (to land or freshwater habitat)	Siltation rate changes (low)	Siltation rate changes (high)	Penetration and/or disturbance of the substrate below the surface of the seabed	Shallow abrasion/penetration: damage to seabed surface and penetration	Surface abrasion: damage to seabed surface features	Physical removal (extraction of substratum)
Pressure Benchmarks	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls	An increase in 10 µGy/h above background level.	None proposed	Compliance with WFD criteria for good status	Compliance with WFD criteria for good status	A deposit of 100gC/m²/yr	Change in 1 folk class for 2 years	Permanent loss of existing saline habitat	5cm of fine material added to the seabed in a single event.	30cm of fine material added to the seabed in a single event.	Structural damage to seabed >25mm	Damage to seabed surface and penetration ≤25mm	Damage to seabed surface features	Extraction of sediment to 30cm
Anotrichium barbatum	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	H (L)	H (L)	H (L)	H (L)	H (L)	H (L)	H (L)	H (L)
Cruoria cruoriaeformis	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (L)	H (H)	H (L)	H (L)	H (M-H)	H (M)	H (L)	H (M)
Dermocorynus montagnei	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	H (L)	H (L)	H (L)	H (L)	H (L)	H (L)	H (L)	H (L)
Lithothamnion corallioides	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (L)	H (M)	H (L)	H (L)	H (L)	H (M-H)	H (M-H)	H (L)	H (M)
Padina pavonica	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	H (M)	H (L)	M (M)	H (L)	H (M)	H (M)	H (M)	H (M)
Phymatolithon calcareum	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	H (L)	H (L)	H (H)	H (L)	H (L)	H (M-H)	H (M)	H (L)	H (M)
Alkmaria romijni	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (M)	H (H)	H (L)	H (L)	M (L)	M (L)	M (L)	H (L)
Armandia cirrhosa	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NS (L)	No Evid. (L)	M (L)	M (L)	M (L)	H (L)
Gobius cobitis	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	H (L)	L (L)	L (L)	M (L)	M (L)	M (L)	M (L)
Gobius couchi	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	H (L)	L (L)	L (L)	M (L)	M (L)	M (L)	M (L)
Hippocampus guttulatus	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NS (L)	NA (L)	M (L)	M (L)	M (L)	M (L)
Hippocampus hippocampus	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NS (L)	NA (L)	M (L)	M (L)	M (L)	M (L)
Victorella pavida	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (H)	H (L)	M (L)	H (L)	H (L)	H (L)	H (L)	H (L)
Arachnanthus sarsi	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	L (L)	H (L)	M (L)	M (L)	M (L)	M (L)	M (L)	M (L)
Alcyonium hibernicum	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (M)	H (L)	M (L)	M (L)	M (L)	M (L)	M (L)	M (L)
Amphianthus dohrnii	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (M)	H (L)	H (L)	H (M)	H (M)	H (M)	H (M)	H (M)
Edwardsia timida	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	M (L)	M (L)	M (L)	M (L)	M (L)	M (L)
Eunicella verrucosa	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (M)	H (L)	H (L)	H (M)	H (M)	H (M)	H (M)	H (M)
Haliclystus auricula	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NA (L)	NA (L)	H (L)	H (L)	H (L)	H (L)
Leptopsammia pruvoti	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (M)	H (L)	M (M)	H (M)	H (M)	H (M)	H (M)	H (M)
Lucernariopsis campanulata	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NA (L)	NA (L)	H (L)	H (L)	H (L)	H (L)
Lucernariopsis cruxmelitensis	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NS (L)	M (L)	M (L)	L (L)	L (L)	M (L)
Parazoanthus anguicomus	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	No Evid. (L)	H (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)
Nematostella vectensis	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (L)	H (L)	NS (L)	L (L)	M (L)	L (L)	L (L)	M (L)
Gammarus insensibilis	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	NS (M)	H (L)	NS (L)	H (M)	H (M)	H (M)	H (M)	H (M)
Gitanopsis bispinosa	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	No Evid. (L)	NE (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)
Mitella pollicipes	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NS (L)	NS (L)	M (L)	M (L)	M (L)	M (L)
Palinurus elephas	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	M (L)	H (H)	H (M)	NS (L)	M (L)	H (H)	H (H)	NS (H)	H (H)
Leptometra celtica	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	No Evid. (L)	NE (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)
Arctica islandica	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (H)	H (L)	H (L)	NS (L)	H (L)	H (H)	H (H)	NS (L)	H (M)
Atrina pectinata	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	M (L)	NA (L)	H (L)	M (L)	H (L)	H (L)	H (L)	M (L)	H (L)
Caecum armoricum	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	H (M)	H (M)	H (L)	H (L)	L (L)	NS (L)	NS (L)	H (L)
Glossus humanus	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	M (L)	H (L)	NS (L)	H (L)	H (H)	H (H)	NS (L)	H (M)
Ostrea edulis	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (M)	H (H)	H (L)	H (L)	H (L)	M (M)	M (L)	M (L-M)	M (M)
Paludinella littorina	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	No Evid. (L)	H (L)	H (L)	H (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)	No Evid. (L)
Tenellia adspersa	NS (L)	NS (L)	NS (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	H (L)	H (L)	H (L)	L (L)	L (L)	L (L)	M (L)

Pressure theme	Other physical pressures						Biological pressures					
Pressure / Species	Electromagnetic changes	Litter	Introduction of light	Underwater noise	Barrier to species movement	Death or injury by collision	Visual disturbance	Genetic modification&translocation of indigenous species	Introduction of microbial pathogens	Introduction or spread of non-indigenous species	Removal of target species	Removal of non-target species
Pressure Benchmarks	Local electric field of 1V m-1; Local magnetic field of 10µT.	None proposed	None proposed	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site	10% change in tidal excursion, or temporary barrier to species movement over≥ 50% of water body width.	0.1% of tidal volume on average tide, passing through artificial structure	None proposed	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives	The introduction of microbial pathogens *Bonamia* and *Martelia refringens* to an area where they are currently not present.	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) ; creation of new colonization space >1ha. One or more INS in Table C3 (Technical Report) has been recorded in the relevant habitat	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	Removal of features through pursuit of a target fishery at a commercial scale.
Anotrichium barbatum	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	M (L)
Cruoria cruoriaeformis	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	H (L)	NE (L)	H (L)
Dermocorynus montagnei	NS (L)	NA (L)	NA (L)	NS (L)	NE (L)	NE (L)	NS (L)	NE (L)	NS (L)	M (L)	NE (L)	NS (M)
Lithothamnion corallioides	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NS (L)	NE (L)	NS (L)	H (L)	H (L)	H (L)
Padina pavonica	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	H (L)	NE (L)	NS (L)
Phymatolithon calcareum	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	H (L)	H (L)	H (L)
Alkmaria romijni	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	L (L)
Armandia cirrhosa	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	L (L)
Gobius cobitis	NS (L)	NA (L)	NA (L)	M (L)	L (L)	M (L)	NA (L)	NE (L)	NS (L)	NS (L)	NE (L)	NE (L)
Gobius couchi	NS (L)	NA (L)	NA (L)	M (L)	L (L)	M (L)	NA (L)	NE (L)	NS (L)	NS (L)	NS (L)	H (L)
Hippocampus guttulatus	NS (L)	NA (L)	NA (L)	M (L)	M (L)	H (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	H (H)
Hippocampus hippocampus	NS (L)	NA (L)	NA (L)	M (L)	M (L)	H (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	H (H)
Victorella pavida	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	L (L)
Arachnanthus sarsi	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	NS (L)	NS (M)	M (L)
Alcyonium hibernicum	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	M (L)
Amphianthus dohrnii	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	H (M)
Edwardsia timida	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	M (L)
Eunicella verrucosa	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	H (M)
Haliclystus auricula	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (H)	H (H)
Leptopsammia pruvoti	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	NS (M)
Lucernariopsis campanulata	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (H)	H (H)
Lucernariopsis cruxmelitensis	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (H)	NS (L)
Parazoanthus anguicomus	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	NS (L)	NS (L)	No Evid. (L)
Nematostella vectensis	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	NS (L)
Gammarus insensibilis	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	L (L)	NA (L)	NE (L)	NS (L)	L (L)	NS (L)	L (L)
Gitanopsis bispinosa	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	NS (L)	NS (L)	No Evid. (L)
Mitella pollicipes	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	NS (L)	NE (L)	NE (L)
Palinurus elephas	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	H (L)	NS (M)	NS (L)	H (M)	NS (M)
Leptometra celtica	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	NS (L)	NS (L)	NA (L)
Arctica islandica	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	NS (L)	NS (L)	H (L)
Atrina pectinata	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	H (L)	NS (L)	H (L)
Caecum armoricum	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	NS (L)
Glossus humanus	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	M (L)
Ostrea edulis	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	H (M)	H (L-M)	H (H)	NS (L)
Paludinella littorina	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	NS (L)	NE (L)	NE (L)
Tenellia adspersa	NS (L)	NA (L)	NA (L)	NS (L)	NS (L)	NS (L)	NA (L)	NE (L)	NS (L)	M (L)	NS (L)	NS (L)

Annex C. Pressure Benchmarks

Table C1: Pressure definitions and benchmarks

Pressure theme	Pressure	Definition and examples associated activities	Pressure Benchmark for assessment			Justification
			Low-Medium	Medium	Medium-High	
Climate change	Atmospheric climate change	Long-term changes in atmospheric temperature. Primarily relevant to intertidal features Factors such as air temp, wind speed and insolation may influence desiccation and it is considered appropriate to restrict assessments to intertidal features.	Increases of 0.9-1.1°C winter-summer) by 2050s	Increases of 3.5-4.6 °C (winter-summer) by 2050s	Increases of 3.8-5.2 °C winter-summer) by 2050s	UKCP09 provides estimates of increases in air temp and rainfall. However, they vary by marine region (from north to south). Figures given are for London, and represent changes in daily mean temperature by 2050s. **Only features occurring in the intertidal are considered to be exposed to this pressure and, therefore, only these are assessed for the sensitivity matrix.**
	pH changes	Long term changes in pH, reductions in pH lead to acidification of the ocean".	Mean 0.1 pH decrease by 2050	Mean 0.2 pH decrease by 2050	Mean 0.5 pH decrease by 2050	Blackford & Gilbert (2007) suggest an average decrease of 0.1 pH units in the next 50 years, and 0.5 pH by 2100 from pre-industrial background. **Not assessed-** although empirical and expert evidence exists for sensitivity for some features time and resource constraints meant this pressure could not be assessed.
	Temperature changes - regional/ national	Long term change in sea water temperature, based on predicted temperature change by UKCP	1.5 °C increase in sea water temperature by 2100	1.5-4 °C increase in sea water temperature by 2100	> 4 °C increase in sea water temperature by 2100	UKCP09 suggests a 1.5-4 °C increase in sea temperature by 2100.
	Salinity changes – regional/ national	Long term changes in salinity based on OPEG draft		0.2 psu decrease by 2100		**Not assessed at workshop- all features considered not sensitive** UKCP09 suggests that the seas will be ca 0.2 psu fresher by 2100.
	Water flow (tidal & ocean current) changes - regional/ national	Long term change (increase or decrease) in water flow due to change in tidal flow, ocean currents etc	A change (increase or decrease) in peak mean spring tide flow speed <0.1m/s over an area <1km^2 or 50% of width of water body for less than 1 year	A change (increase or decrease) in peak mean spring tide flow speed of between 0.1 to 0.2m/s over an area >1km^2 or 50% of width of water body for more than 1 year	A change (increase or decrease) in peak mean spring tide flow speed of >0.2m/s to 0.5m/s over an area >1km^2 or 50% of width of water body for more than 1 year	The benchmarks are based on changes in peak mean spring tide flow speed and broad implications for changes in erosion and deposition.
	Emergence regime changes (sea level) - regional/ national	Long term change in sea level and result changes in emergence regime, especially relevant in areas where the intertidal cannot realign due to coastal defence or cliffs	Increased ASL of 18 cm by 2050 in London	Increased ASL of 21 cm by 2050 in London	Increased ASL of 25 cm by 2050 in London	Based on UKCP09 predictions for London. NB there will be very different sensitivities for habitats (which are defined by position of low water mark) and species (for which overall emergence regime will be more important). **Most features will not be sensitive, assessments are based on those features where the lower limits of extent are determined by the tidal range e.g. saltmarsh.**
	Wave exposure changes - regional/ national	Long term change in wave exposure due to changes in sea level coupled with increased storminess	A change (increase or decrease) in nearshore significant wave height <3%.	A change (increase or decrease) in nearshore significant wave height >3% but <5%.	A change (increase or decrease) in nearshore significant wave height >5% but <10%.	UKCP09 predicts an increase in the significant wave height in S and SW and reduction in N, in the range of -1.5 to +1 m. For rocky environments, main pressure will relate to physical effect on features. For sedimentary environments, main pressure will relate to effects of changes in wave energy on sediment transport and morphology. **Features that are restricted to deeper waters (>200m) are blocked as 'Not Exposed' in the sensitivity matrix as these are unaffected by wave action.**
Hydrological changes (inshore/ local)	Temperature changes local	Local (site) increases or decreases in sea water temperature. Most likely caused by thermal discharges.	A 2 °C change (increase or decrease) in temperature for 1 month,	A 5 °C change (increase or decrease) in temp for a one month period, or 2° C for one year	A >5 °C change (increase or decrease) for a >1 month	The ambient temperature of sea water changes with season, the magnitude of the change varying from year to year. However, short or long term changes in temperature may also result from thermal discharges (e.g. power station cooling waters) or climate change. Thermal discharges are likely to be between 2° C and 10° C above the ambient temperature (UNEP 1984). UNEP (1984) recommend an impact assessment level for thermal discharge plumes of equal to or greater than 3 °C. WGTAG working group recommended a MAC of 2 °C at the edge of the thermal plume mixing zones, together with a maximum of 21.5 °C as a 98%ile..
	Salinity changes - local	A shift in the salinity regime. This may result from sudden drops in salinity due to excessive freshwater runoff (flood events), or hypo and hyper saline effluents. Also changes in channels and hydrography may result in changes in the water table and the freshwater wedge in estuarine habitats	**Increase** from 35 to 38 units for one month **Decrease** in salinity by 1 unit for a year or 4 units for one month	**Increase** from 35 to 38 units for one year **Decrease** in salinity by 4-10 units for a year	**Increase** from 35 to 38 units or more for over one year **Decrease** in salinity by >10 units for one month or more.	Benchmark split into increase and decrease, as it was felt that most organisms would be relatively more sensitive to increases in salinity over full (35). The decrease benchmark is based on the MNCR scale of biologically significant salinity regimes.
	Water flow (tidal current) changes - local	Changes in the movement of water associated with infrastructure developments (e.g. coastal defences, oil and gas, artificial reefs) extraction activities.	A change (increase or decrease) in peak mean spring tide flow speed <0.1m/s over an area <1km^2 or 50% of width of water body for less than 1 year	A change (increase or decrease) in peak mean spring tide flow speed of between 0.1 to 0.2m/s over an area >1km^2 or 50% of width of water body for more than 1 year	A change (increase or decrease) in peak mean spring tide flow speed of >0.2m/s to 0.5m/s over an area >1km^2 or 50% of width of water body for more than 1 year	The benchmark is based on changes in peak mean spring tide flow speed, taking account of typical changes in flow speed and broad implications for changes in erosion and deposition.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone) - The time spent emersed and exposed to air. Intertidal species are regularly emersed with the falling tide, the percentage of time emersed is dependent on their position or height on the shore relative to the tide. Habitats and landscapes defined by intertidal zone – changes in water levels reducing the extent of the intertidal zone	**Intertidal species (and habitats not uniquely defined by intertidal zone)** A 2 hour change in the time covered or not covered by the sea for 1 month **Habitats and landscapes defined by intertidal zone** An increase in relative sea level or decrease in high	**Intertidal species (and habitats not uniquely defined by intertidal zone)** A 1 hour change in the time covered or not covered by the sea for a period of 1 year. **Habitats and landscapes defined by intertidal zone** An increase in relative sea level or decrease in high	**Intertidal species (and habitats not uniquely defined by intertidal zone)** A 6 hour change in the time covered or not covered by the sea for one month or a 3 hour for one year. **Habitats and landscapes defined by intertidal zone** An increase in relative sea	Local changes likely to be due to artificial structures, e.g. barrages, port development and dredging, that can affect natural tidal range. The benchmark is split between species (and certain habitat) effects (as a result of gross changes in emergence regime) and intertidal habitat and landscape effects (where small changes in water levels can affect the extent of features that are uniquely defined by high and low water marks) .

Pressure theme	Pressure	Definition and examples associated activities	Pressure Benchmark for assessment			Justification
			Low-Medium	Medium	Medium-High	
			water level of 1-10 mm for one month over a shoreline length >1km	water level of 1 mm for one year over a shoreline length >1km	level or decrease in high water level >1-10mm for >1 year over a shoreline length >1km	
	Wave exposure changes - local	Exposure on an open shore is dependent upon the distance of open seawater over which wind may blow to generate waves (the fetch) and the strength and incidence of the winds. Wave exposure can be expressed as a percentage change in significant wave height.	A change (increase or decrease) in nearshore significant wave height <3%	A change (increase or decrease) in nearshore significant wave height >3% but <5%	A change (increase or decrease) in nearshore wave height >5% but <10%	The benchmark is based on changes in nearshore significant wave height taking account of experience from marine aggregate Coastal Impact Studies (changes in nearshore significant wave height of 2-3% are not considered to be significant)
	Water clarity changes	The turbidity (clarity or opacity) of sea water is dependant on the concentration of substances that absorb or scatter light, including inorganic and organic particulates and dissolved coloured substances.	A change (increase or decrease) in one rank, e.g. from clear to turbid (100-300 mg/l) for one month.	A change (increase or decrease) in one rank on the WFD scale, e.g. from clear to turbid for one year	A change (increase or decrease) from clear to very turbid for one year or more.	The pressure benchmark is based on the WFD scale which uses relative suspended particulates to derive a scale of turbidity from very high to clear. Coastal waters range from 10-100 mg/l, which is ranked as clear. The ranks are shown below in Table C2.
Pollution and other chemical changes	Non-synthetic compound contamination	Incl. heavy metals, hydrocarbons, produced water in water, sediments and biota		Compliance with all AA EQS, conformance with PELs, EACs/ ER-Ls	Any exceedances <150% EQS PELs or EACs, below ER-M	**Not assessed at workshop- all features considered not sensitive** Water column annual average (AA) environmental quality standards (EQS) provide high levels of protection for all living organisms. Canadian interim sediment quality guidelines (ISQG) Probable Effects Levels (PELs) provide an indication of sediment risks. OSPAR Environmental Assessment Criteria (EACs) and Effects Range- Low (ER-Ls) criteria provide guidelines for sediment risks. There are also some OSPAR EACs for biota.
	Synthetic compound contamination	Incl. pesticides, anti-foulants, pharmaceuticals in water, sediments and biota		Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls	Any exceedances <150% EQS PELs or EACs, below ER-M	**Not assessed at workshop- all features considered not sensitive** Water column annual average (AA) environmental quality standards (EQS) provide high levels of protection for all living organisms. Canadian interim sediment quality guidelines (ISQG) Probable Effects Levels (PELs) provide an indication of sediment risks. OSPAR Environmental Assessment Criteria (EACs) and Effects Range- Low (ER-Ls) criteria provide guidelines for sediment risks. There are also some OSPAR EACs for biota.
	Radionuclide contamination	Introduction of radioactive nuclides.		10 µGy/h		**Not assessed at workshop- all features considered not sensitive** Precautionary dose rate 10 µGy/h (microGrays per hour) from OSPAR (2008). These levels not encountered in OSPAR area.
	Introduction of other substances (solid, liquid or gas)	e.g. LNG and CO_2 although such introductions would constitute unplanned releases		None proposed		**Not Assessed**
	De-oxygenation	Reduction in water column dissolved oxygen concentration, arising from disposal of biological wastes to the marine environment.	Compliance with WFD criteria for moderate status	Compliance with WFD criteria for good status	Compliance with WFD criteria for high status	**Not assessed at workshop- all features considered not sensitive.** Good information exists on compliance with WFD criteria in estuarine and coastal waters. In offshore waters status can be assumed to be high as there are no significant pressures. For fully saline waters, the WFD standard for good status is 4mg/l, compared to a suggested level of 5mg/l in WQTAG 088e. However, all fully saline waters already meet high status (>5.7mg/l). Within estuaries, the WFD standard for good status is 5-(0.028xsalinity) compared to a suggested level of 6-(0.028xsalinity) in WQTAG088e. The latter standard is more precautionary as it also seeks to protect migratory fish, which are likely to be the most sensitive element.
	Nutrient enrichment	Water column concentration of dissolved inorganic nitrogen	Compliance with WFD criteria for moderate status	Compliance with WFD criteria for good status	Compliance with WFD criteria for high status	**Not assessed at workshop- all features considered not sensitive.** Ideally, pressure would be assessed in terms of increases in nutrient loading over background. However, such information is not readily available. As a surrogate it is possible to use information from WFD and CEMP assessments in relation to winter concentrations of DIN (a measure of state) and compare these to WFD standards and status classification outputs
	Organic enrichment	Increase in annual rate of deposition of organic carbon to sea bed		$100gC/m^2/yr$	$300gC/m^2/yr$	Evidence from wastewater outfall studies for UWWTD and from cage fish farm monitoring indicate that deposition rates of $>100gC/m^2/yr$ are capable of affecting benthic communities. Typical primary production rates in North Sea may be between $200\text{-}400gC/m^2/yr$ depending on degree of eutrophication but not all of this production reaches sea bed.
Physical loss	Physical loss (to land or freshwater habitat)	Physical loss arising from coastal defence and land claim		Permanent loss of existing saline habitat		The benchmark refers to the permanent loss of habitat to land or freshwater, offshore/deep water habitats are considered to be 'not exposed' to this pressure while theoretically all coastal features are highly sensitive to loss of habitat.
	Physical change (to another seabed type)	Physical change arising from extraction (navigational dredging), infrastructure, waste disposal, shellfish harvesting, beach replenishment.	Change in 1 Folk class for 6 months	Change in 1 Folk class for 2 years	Change in 1 Folk class for 10 years	Benchmark incorporates both a change in seabed type and a temporal aspect. Folk class relates to modified Folk triangle used for EUNIS classification. The benchmark takes account of recovery timescales (separating features where species have annual/semi annual life histories) and is therefore intended to be ecologically relevant.
Physical damage	Habitat structure changes - removal of substratum (extraction)	Physical extraction of substratum including biogenic features (maerl) through navigational dredging, quarrying, and aggregate (sand and gravel) extraction,	Extraction of surficial deposits only	Extraction of sediment to 30cm	50cm and deeper general limit of shallowest maintenance dredging	The benchmark is based on a single event that removes sediment material to the depth of 30 cm and that exposes sediments/substrate of the same type e.g. not habitat change but habitat loss.

Pressure theme	Pressure	Definition and examples associated activities	Pressure Benchmark for assessment			Justification
			Low-Medium	**Medium**	**Medium-High**	
	Structural abrasion/ penetration: Structural damage to seabed >25mm	The pressure refers to structural damage to features e.g. deep disturbance of sediment, upheaval and piling of boulders		Structural damage to seabed >25mm		**The assessment should consider the direct impact arising from the pressure on the feature**
	Shallow abrasion/ penetration: damage to seabed surface and penetration ≤25mm	The assessment considers penetration and disturbance of the sediment to 25mm or scoring on rocks.		Damage to seabed surface and penetration ≤25mm		**The assessment should consider the direct impact arising from the pressure on the feature**
	Surface abrasion: damage to seabed surface features	Impacts confined to the surface e.g. damage to epifauna/flora on sediment and rock.		Damage to seabed surface features		**The assessment should consider the direct impact arising from the pressure on the feature directly on the feature.**
	High siltation rate changes	Addition of fine materials to seabed arising from dredgings disposal, sewage disposal, etc interpreted as smothering.	10-20cm	30cm of fine material added to the seabed in a single event.	40-50cm	The pressure benchmark refers to the addition of 30 cm of fine material in a single or short-term event. The benchmark does not include a specific temporal component for the duration of the pressure as the removal of the deposited material will depend on habitat characteristics (degree of exposure to wave action, water flow etc) and is therefore a characteristic of the feature which will mitigate the sensitivity of the feature to the impact. Organic enrichment effects e.g. from sewage are assessed separately, this pressure takes into account the physical smothering/siltation effects on the habitat.
	Low siltation rate changes	Addition of fine materials to seabed arising from dredging, sewage disposal.	1cm of fine material added to seabed	5cm of fine material added to the seabed in a single event.	20-30 cm	Informed by MarLIN benchmark. As above, the assessment refers to a single event and should take into account the habitat characteristics associated with the feature that will determine the persistence of the deposit (degree of exposure to wave action, water flow etc.)
Other physical pressures	Litter	Abundance of microplastic particles		None proposed		**Not assessed**. Galgani *et al* (2010) suggest it is not possible to establish meaningful indicators at this time. The most likely pressure metric would be number of microplastic particles in the stomachs of representative species
	Electromagnetic changes	Changes in local electric and magnetic fields associated with power and telecoms cables		Local electric field of 1V m-1; Local magnetic field of 10μT.		**Not assessed at workshop- all features considered not sensitive** Potential effects on a range of invertebrate species have been identified (ICES, 2003; Gill *et al*, 2005; OSPAR, 2008). OSPAR (2008) states that 'In regard to effects on fauna it can be concluded that there is no doubt that electromagnetic fields are detected by a number of species and that many of these species respond to them. However, threshold values are only available for a few species and it would be premature to treat these values as general thresholds. The significance of the response reactions on both individual and population level is uncertain if not unknown.' . The geomagnetic field in the North Sea is approximately 50 μT. The naturally occurring electric fields are around 25 μV m-1. Responses by some elasmobranchs were detected at 8μT and 2.2μV m-1 (Gill *et al*, 2009) but elasmobranchs are many orders of magnitude more sensitive compared to teleost fish. For example, Poléo *et al* (2001) indicates that marine teleost (bony) fish show physiological reactions to electric fields at minimum field strengths of 7 mV m-1 and behavioural responses at 0.5-7.5 V m-1. The latter might tentatively be used as a benchmark for MCZ features. Such strong electric fields would not occur in the vicinity of electric power or telecoms cables. If a benchmark was required for magnetic field distortion, this might be set at 10 μT (20% of natural magnetic field). This is higher than the magnetic fields measured in the vicinity of OWF cables (Gill *et al*, 2009)
	Underwater noise changes	Changes in underwater noise (sound pressure levels)	MSFD indicator levels (SEL or peak SPL) exceeded for 5% of days in calendar year within site	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site.	MSFD indicator levels (SEL or peak SPL) exceeded for 50% of days in calendar year within site	**Not assessed at workshop- all features considered not sensitive except for MCZ fish features** OSPAR 2009 concludes that 'There are currently no reliable data available on hearing damage in sea turtles or invertebrates as a result of exposure to anthropogenic noise.' Tasker *et al* (2010) suggest indicators that might be applied for the protection of cetaceans and fish in relation to the assessment of Good Environmental Status under the MSFD which could be used as benchmarks, for example, 'the proportion of days within a calendar year, over areas of 15'N x 15'E/W in which anthropogenic sound sources exceed either of two levels, 183 dB re 1μPa2.s (i.e. measured as Sound Exposure Level, SEL) or 224 dB re 1μPapeak (i.e. measured as peak sound pressure level) when extrapolated to one metre, measured over the frequency band 10 Hz to 10 kHz'.. No suitable measures currently exist in relation to the assessment of particle motion.
	Introduction of light	Changes in surface (intertidal) and subsurface (photic depth) light levels		None proposed		**Not assessed at workshop- all features considered not sensitive.** Not considered in MSFD indicators assessment 'due partly to their relatively localised effects, partly to a lack of knowledge and partly to lack of time to cover these issues' (Tasker *et al* 2010). Little information on response of fauna to light; light climate will influence growth of macroalage and saltmarsh and penetration depth of macroalgae, but influences are likely to be localised.
	Barrier to species movement	Changes in mean spring tidal excursion distance		10% decrease in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.	30% decrease in tidal excursion or significant permanent barrier to species movement.	Barriers to species movement could occur through loss or damage to one or more functionally related sites or through reductions in tidal excursion which reduce connectivity between sites. Disruption of dispersal of benthic species could in turn affect habitat types. Few, if any, human activities are likely to significantly affect connectivity directly (e.g. barrages, barriers) or indirectly

Pressure theme	Pressure	Definition and examples associated activities	Pressure Benchmark for assessment			Justification
			Low-Medium	Medium	Medium-High	
						(e.g.water quality barrier in estuary).
	Death or injury by collision	Changes in survivorship (adult/juvenile mortality or fecundity) during passage through structure		0.1% of tidal volume on average tide, passing through artificial structure	>1% of tidal volume on average tide, passing through artificial structure	**Death/injury could potentially occur to mobile species (e.g. Giant or Couch's goby, long-snouted or short-snouted seahorse) or species with sensitive life stages (e.g. ovigerous species – lagoon sand shrimp, *Gitanopsis bispinosa* (amphipod shrimp) or spiny lobster).** Risks to mobile species passing through tidal energy barrages are high (e.g. STP 2010 Fish Topic Paper). Risks to ovigerous species may also be significant (e.g. STP 2010, Marine Ecology Topic Paper). Henderson *et al*. (2007) estimated that Hinkley power station removed between 0.001 to 1% of the *Crangon* population in the Severn Estuary based on an abstraction rate of 0.1% of mean spring tide volume.
Biological pressures	Visual disturbance	Disturbance associated with visual detection of people, vessels, vehicles, gear or structures.		None proposed		**Not assessed at workshop- all features considered not sensitive** There is little information on the effects of visual disturbance on marine fish or benthic fauna or what relevant thresholds might be.
	Genetic modification & translocation of indigenous species	Translocation or genetic modification of aquaculture species	Translocation within same geographic area; release of hatchery-reared juveniles within same geographic area.	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives		This pressure could be associated with the translocation of mussels, oysters and scallops or genetic modification of oysters, scallops or other cultivated species. Translocation could also occur as a result of ballast water discharge or transfer on ships' hulls, although it may be difficult to differentiate between natural range expansion and/or anthropogenic translocation. **Assessment is based on whether the feature is a species that is likely to be cultivated in hatcheries e.g. crustaceans as this would be a pathway to genetic modification of existing populations. Other features are assessed as 'not exposed'.**
	Introduction or spread of non-indigenous species (NIS)	Introduction of, or facilitation of the spread of, NIS		A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	Multiple pathways exist for introduction of one or more invasive NIS; creation of new colonization space >10ha	Olenin *et al* (2010) suggest a number of indicators of state in relation to: number of NIS recorded in an area; Abundance and distribution range of NIS; NIS impact on native communities; NIS impact on habitats; NIS impact on ecosystem functioning. Olenin *et al* (2007) promote an index for assessing biopollution level which can also be used to inform the development of management measures. The relative pressure from NIS is a function of the number and nature of introduction pathways, availability of colonization space and the invasiveness of individual species. **The risk assessment to determine sensitivity is based on the presence of introduction pathways for invasive non-indigenous species (INS), previous occurrences of INS in the relevant habitat, and the sensitivity of the feature to these. Deepwater offshore habitats are judged to be not exposed due to the absence of pathways.**
	Introduction of microbial pathogens	Translocation or introduction of species known to carry harmful microbial pathogens associated with historic impacts		The introduction of microbial pathogens *Bonamia* and *Martelia refringens* to an area where they are currently not present.		There are relatively few documented impacts of the introduction of microbial pathogens resulting in significant impacts. The two most commonly recorded occurrences relate to the introduction of *Bonamia* and *Martelia refringens* (protozoan parasites) to native oyster populations. **The pressure benchmark relates to native oyster populations and by extension habitats where this is a characterising species. If oysters are not associated with the feature the sensitivity assessment is 'not exposed'.**
	Removal of target species	Commercial harvesting of features of conservation importance or sub-features of habitats of conservation importance. Commercial harvesting of higher predators (e.g. fish) which may have indirect effects on habitats and species of conservation importance.		Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	Removal of target species within a quota that has not been subject to appropriate assessment	Sensitivity to removal of target species is only considered where an MCZ feature or an *a-priori* <u>selected characterising element</u> of a feature is being directly targeted (e.g. native oyster or cockle (as part of intertidal mudflat assemblage). **The assessment required is a judgement of the sensitivity of target species to commercial levels of fishing pressure using static or towed gears.**
	Removal of non-target species	Removal of non-target features of conservation importance or sub-features of habitats of conservation through commercial harvesting.		Removal of features through pursuit of a target fishery at a commercial scale.		For non-target species removal, consideration is limited to the extent of by-catch or removal of MCZ features or components that is likely to occur, given a knowledge of the types of biological extraction activities that might be occurring in the vicinity of the feature. For example, if beam trawling is likely to occur in an area, most of the large epifauna/flora might be expected to be removed/retained although smaller components may escape through the cod end and infaunal components may escape capture. **The assessment required is a judgement of the sensitivity of non-target species to commercial levels of harvesting within the feature (e.g. fishing pressure using static or towed gears or seaweed harvesting etc). For the assessed features this pressure is likely to be strongly correlated with physical abrasion pressure.**

Pressure Benchmarks

Low-medium: pressure level representative of a low/medium pressure based on range of pressure levels encountered in UK waters

Medium: pressure level representative of a medium pressure based on range of pressure levels encountered in UK waters <u>or</u> representative of ecologically significant threshold

Medium-high: pressure level representative of a medium/high pressure based on range of pressure levels encountered in UK waters

Table C2: Water turbidity ranks (based on WFD 2009) based on mean concentration of suspended particulate matter mg/c)

Water Turbidity	Definition
>300	Very Turbid
100-300	Medium Turbidity
10-100	Intermediate
<10	Clear

Table C3: Key invasive non-indigenous species

Species	Habitats in Which Species has Occurred
Codium fragile subsp tormentosoides	May dominate algal cover in infralittoral rocky reefs
Sargassum muticum	May dominate algal cover on sheltered rocky and coarse substrate shores penetrating into estuaries
Undaria pinnatifida	May dominate algal cover on rocky shores from low tide down to 15m
Spartina anglica	May dominate lower saltmarsh
Marenzelleria viridis	May dominate faunal assemblage in low salinity shallow subtidal muds
Eriocheir sinensis	Structuring component of high intertidal in upper estuaries
Crepidula fornicata	May smother subtidal muddy and sandy seabeds
Urosalpinx cinerea	Predator on oysters
Crassostrea gigas	May form oyster beds on coarse/hard substrates in estuaries
Perophora japonica	May cover up to 10% of seabed surface in lagoons
Didemnum vexillum	May encrust submerged structures but may also affect sheltered shallow subtidal hard substrates

Table C4: Modified Folk Scale (from Long 2006)

Categories
Mixed sediment
Coarse sediment
Mud and sandy mud
Sand and muddy sand

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Annex D. Feature Elements used in Assessments

Table D1

Broadscale habitats	Pro-forma Code 1 –	Pro-forma Code 4 1	Pro-forma Code 6
High energy intertidal rock		Barnacles, limpets, Porphyra, few fucoids, *Alaria esculenta*, *Himenthalia elongata*.	Estuarine rocky habitats Blue mussel beds *Mitella pollicipes* -Gooseneck barnacle Horse mussel beds *Anotrichium barbatum* -Bearded red seaweed *Cruoria cruoriaeformis* -Red seaweed *Dermocorynus montagnei* -Red seaweed Intertidal under boulder communities
Moderate energy intertidal rock			Estuarine rocky habitats Intertidal under boulder communities littoral chalk communities Blue mussel beds
Low energy intertidal rock			Estuarine rocky habitats Egg wrack beds
Intertidal coarse sediment	Eunis codes, A2.111, A2.112. A2.12		
Intertidal sand and muddy sand			Intertidal mudflats Blue mussel beds
Intertidal mud	Intertidal mud		Intertidal mudflats
Intertidal mixed sediments	Intertidal muds and sands supporting gaper clam; Stable spp. rich mixed sediments		Sheltered muddy gravels Intertidal mudflats
Coastal saltmarshes and saline reedbeds			Coastal saltmarsh
Intertidal sediments dominated by aquatic angiosperms			Seagrass beds
Intertidal biogenic reefs			*Sabellaria alveolata* reefs Blue mussel beds

Broadscale habitats	**Pro-forma Code 1 –**	**Pro-forma Code 4 1**	**Pro-forma Code 6**
High energy infralittoral rock			
Moderate energy infralittoral rock			
Low energy infralittoral rock			
High energy circalittoral rock			Fragile sponge and anthozoan communities on subtidal rocky habitat *Eunicella verrucosa* Northern sea fan communities
Moderate energy circalittoral rock§			Northern seafan communities Fragile sponge and anthozoan communities on subtidal rocky habitats *Sabellaria spinulosa* reefs Blue mussel beds *Musculus discors* beds
Low energy circalittoral rock§	Coarse sands and gravels with communities characterised by large/ long lived bivalves		
Subtidal coarse sediment	Subtidal sand and gravel with long lived bivalves		Subtidal sands and gravels *Edwardsia timidia*
Subtidal sand	Stable subtidal fine sand		Subtidal sands and gravels
Subtidal mud	Stable muddy sands, sandy muds and mud		Sea-pen and burrowing megafauna communities Burrowed mud Inshore deep mud with burrowing heart urchins
Subtidal mixed sediments	Stable muddy sands, sandy muds and mud; Stable spp. rich mixed sediments		Subtidal mixed muddy sediments *Ostrea edulis* beds
Subtidal macrophyte-dominated sediment			Maerl beds Maerl or coarse shell gravel with burrowing sea cucumbers Kelp and seaweed communities on sublittoral sediment Seagrass beds

Broadscale habitats	Pro-forma Code 1 –	Pro-forma Code 4 1	Pro-forma Code 6
Subtidal biogenic reefs	Biogenic reef on sediment and mixed substrate		*Sabellaria spinulosa* *Sabellaria alveolata* Horse mussel beds Blue mussel beds
Deep-sea bed	The deep sea bed is a EUNIS level 2 classification and therefore includes all the deep sea broadscale habitats in the matrix- the assessment was based on the range of sensitivities assessed for these.		
Deep-sea rock and artificial hard substrata	EUNIS codes A6.11, A6.12; A6.13, Ag.14		
Deep-sea mixed substrata			
Deep-sea sand			
Deep-sea muddy sand			
Deep-sea mud			Mud habitats in deep water
Deep-sea bioherms			Deep sea sponge aggregations
Raised features of the deep-sea bed	Seamounts (Annex G 2.32) and coral carbonate mounds (see Annex G 2.6)		
Deep-sea trenches and canyons, channels, slope failures and slumps on the continental slope			
Vents, seeps, hypoxic and anoxic habitats of the deep sea			

Table D2

Habitats	Elements used in assessment			
	Worksheet Code 1 -	**2 - Marlin and ABPmer**	**3 - Marlin**	**4 – Workshop 1**
Blue Mussel beds (including intertidal beds on mixed and sandy sediments)	Mussels and piddocks on intertidal clay and peat	Mussels as key structural and functional species	*Mytilus edulis* beds on sublittoral sediment *Mytilus edulis* beds with hydroids and ascidians on tide-swept moderately exposed circalittoral rock *Mytilus edulis* and piddocks on eulittoral firm clay	Blue mussels (*Mytilis edulis*)
Burrowed mud			10 example biotope	Based on two biotopes SS.Smu.CFiMu.SpnMeg and SS.Smu.CFiMu.MegMax, seapens, burrowing megafauna including *Nephrops norvegicus* and *Maxmuelleria lankesteri* and characteristics of mud habitats.
Carbonate reefs			None	
Coastal saltmarsh			Pioneer saltmarsh (*.Sm), Sm13 (*Puccinellia maritima*)	
Cold-water coral reefs	Biogenic reef on sediment and mixed substrate		*Lophelia* reefs	Reef
Coral carbonate mounds			None	Cold water coral reefs, coral gardens, deep sea sponge aggregations
Coral Gardens			None	
Deep-sea sponge aggregations			None	Deep sea sponges
Egg wrack beds			Asc.Mac review	*Ascophyllum nodosum*
Estuarine rocky habitats			Several biotopes	Macroalgae and filter feeding species listed on biotope list sheet

Habitats	Elements used in assessment			
	Worksheet Code 1 -	2 - Marlin and ABPmer	3 - Marlin	4 – Workshop 1
File shell/Flame shell beds			*Limaria hians* biotope	Used horse mussel bed assessment as proxy
Fragile sponge & anthozoan communities on subtidal rocky habitats			Example biotopes	Long lived deep sea sponge communities
Intertidal mudflats	Intertidal mud		Example biotopes	
Intertidal under boulder communities			Fser.Fser.Bo	*Fucus serratus* and underboulder fauna e.g encrusting sponges, bryozoans on exposed/Mod exposed eulittoral boulders
Inshore deep mud with burrowing heart urchins			BriAchi	
Kelp and seaweed communities on sublittoral sediment	The biotope SS.SMp.KSwSS		Several Lsac biotopes	*Laminaria saccharina*
Littoral chalk communities			None	Micro algae and green algae and burrowing species as listed on the biotopes list
Maerl beds	Maerl beds		MarLIN assessments are based on PhyHec, Lgla biiotopes, Phycol, SS.SMp.Mrl.Lcor, SS.SMp.Mrl.Lgla	
Maerl or coarse shell gravel with burrowing sea cucumbers	Maerl beds		Nmix	
Horse mussel (Modiolus modiolus) beds	Mussels and piddocks on intertidal clay and peat		*Modiolus modiolus* beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata	
Mud habitats in deep water			Sea pens and burrowing megafauna in circalittoral soft mud *Brissopsis lyrifera* and	*Modiolus modiolus* beds with *Chlamys varia*, sponges, hydroids and bryozoans on slightly tide-swept very

Habitats	Elements used in assessment			
	Worksheet Code 1 -	2 - Marlin and ABPmer	3 - Marlin	4 – Workshop 1
			Amphiura chiajei in circalittoral mud Foraminiferans and *Thyasira* sp. in deep circalittoral soft mud	sheltered circalittoral mixed substrata
Musculus discors beds			*Musculus discors* beds on moderately exposed circalittoral rock	M. discors bed
Northern sea fan communities			*Swiftia* review, CarSwi review	Pink sea fans
Saline lagoons			Few example biotopes	Species and substrate
Sea-pen and burrowing megafauna communities			*SpMeg	
Ostrea edulis beds	Oyster beds		*Ostrea edulis* beds on shallow sublittoral muddy sediment	Used horse mussel bed assessment as proxy
Peat and clay exposures	Mussels and piddocks on intertidal clay and peat		*Mytilus edulis* and piddocks on eulittoral firm clay *Ceramium* sp. and piddocks on eulittoral fossilized peat	Presence of peat and clay exposure
Sabellaria alveolata reefs	Honeycomb worm reefs		*Example biotopes*	
Sabellaria spinulosa reefs			*SspiMx*	
Seagrass beds	Seagrass beds		Znol and Zmar	
Seamounts			None	
Serpulid reefs			*Serpula vermicularis* reefs on very sheltered circalittoral muddy sand	Serpulid reefs.
Shallow tide swept coarse sands with burrowing bivalves	*Moerella* spp. with venerid bivalves in infralittoral gravelly sand (SS.SCS.ICS.MoeVen)		Example biotopes	Burrowing bivalves, gravelly sand substrates, in high energy environment
Sheltered muddy gravels			Example biotopes	
Submarine structures made by leaking gases			None	Sponges and coral
Subtidal chalk			None	Presence of chalk, burrowing infauna, epifauna (algal)

Habitats	Elements used in assessment			
	Worksheet Code 1 -	**2 - Marlin and ABPmer**	**3 - Marlin**	**4 – Workshop 1**
Subtidal mixed muddy sediments	Stable muddy sands, sandy muds and mud; Stable spp. rich mixed sediments		Example biotopes	
Subtidal sands and gravels	Subtidal sand and gravel with long lived bivalves		Example biotopes	Burrowing bivalves, substrate gravelly sand, (high energy)
Tide swept algal communities			Example biotopes	Kelp
Tide-swept channels	Physical conditions including hydrodynamics, e.g. tidal rapids in inshore locations.		Example biotopes depending on definition	Very high water flow dynamics, diverse epifauna (sponge and anthozoans)

Table D3

Species	Elements used in assessment[1]	
	Matrix Code 1	**Matrix Code 4**
Amphianthus dohrnii	Northern sea fan communities (the species is strongly dependent on *Swiftia pallida* (Hill *et al*. 2010)	
Haliclystus auricula	Feature is found on macroalgae and seagrass, the sensitivity assessments are therefore based on the habitat of the species using assessments made for seagrass beds (Annex G 2.31) and kelp and seaweed communities on sediment (Annex G 2.17)	
Lucernariopsis campanulata	Feature is found on macroalgae and seagrass, the sensitivity assessments are therefore based on the habitat of the species using assessments made for seagrass beds (Annex G 2.31) and kelp and seaweed communities on sediment (Annex G 2.17)	
Lucernariopsis cruxmelitensis	Feature is found on macroalgae and seagrass, the sensitivity assessments are therefore based on the habitat of the species using assessments made for seagrass beds (Annex G 2.31) and kelp and seaweed communities on sediment (Annex G 2.17)	
Ostrea edulis		Used horse mussel bed assessment as proxy

Annex E. Matrix Blocking

Pressure theme	Pressure	Initial Blocking (by exposure) [1]	Secondary Blocking (by Pressure Benchmarks) [2]
Climate change	Atmospheric climate change	Subtidal and deepwater features are blocked as 'Not Exposed' to this pressure.	All intertidal features assessed.
	pH changes	**Not Assessed**	
	Temperature changes regional/national	Medium	
	Salinity changes - regional/national		All features blocked as 'Not Sensitive' to the pressure benchmark.
	Water flow (tidal & ocean current) changes - regional/national	No blocking.	
	Emergence regime changes (sea level) - regional/national	Features that are restricted to subtidal and deeper waters are blocked as 'Not Exposed' to this pressure.	Most features will not be sensitive, assessments will be based on those where the lower limits of extent are determined by the tidal range e.g. saltmarsh.
	Wave exposure changes - regional/national	Features that are restricted to deeper waters are blocked as 'Not Exposed' as these are unaffected by wave action.	
Hydrological changes (inshore/local)	Temperature changes - local	Deepwater features are blocked as 'Not Exposed' as these are not judged not to be exposed to this pressure.	
	Salinity changes - local	Deepwater features are blocked as 'Not Exposed' as these are not judged not to be exposed to this pressure.	
	Water flow (tidal current) changes - local	Deepwater features are blocked as 'Not Exposed' as these are not judged not to be exposed to this pressure.	
	Emergence regime changes - local	Features that are restricted to subtidal and deeper waters are blocked as 'Not Exposed' to this pressure.	
	Wave exposure changes - local	Features that are restricted to deeper waters are blocked as 'Not Exposed' as these are unaffected by wave action.	
	Water clarity changes	Features that are restricted to deeper waters are blocked as 'Not Exposed' as these are unaffected by wave action.	

Pressure theme	Pressure	Initial Blocking (by exposure)[1]	Secondary Blocking (by Pressure Benchmarks)[2]
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)		All features were judged to be 'Not sensitive' to the pressure benchmark.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)		All features were judged to be 'Not sensitive' to the pressure benchmark.
	Radionuclide contamination		All features were judged to be 'Not sensitive' to the pressure benchmark.
	Introduction of other substances (solid, liquid or gas)	**Not Assessed** (see Annex C)	
	De-oxygenation		All features were judged to be 'Not sensitive' to the pressure benchmark.
	Nutrient enrichment		All features were judged to be 'Not sensitive' to the pressure benchmark.
	Organic enrichment	No blocking.	
Physical loss	Physical loss (to land or freshwater habitat)	Features that are restricted to deeper waters are blocked as 'Not Exposed' to this pressure.	All remaining features blocked as 'High' sensitivity to loss of habitat.
	Physical change (to another seabed type)	No blocking.	
.Physical damage	Habitat structure changes - removal of substratum (extraction)	No blocking.	
	Penetration and/or disturbance of the substrate below the surface of the seabed	No blocking	
	Heavy abrasion, primarily at the seabed surface	No blocking	
	Light abrasion at the surface only	No blocking	
	Siltation rate changes	No blocking	
Other physical pressures	Litter	Not assessed (see Annex C)	
	Electromagnetic changes		All features were judged to be 'Not sensitive' to the pressure benchmark.
	Underwater noise changes		All features were judged to be 'Not sensitive' to the pressure benchmark.
	Introduction of light	Not assessed (see Annex C)	
	Barrier to species movement	Broadscale habitat and habitat features were	Broadscale habitat and habitat features were

Pressure theme	Pressure	Initial Blocking (by exposure)[1]	Secondary Blocking (by Pressure Benchmarks)[2]
		blocked as Not 'Exposed' as the pressure is not considered to be relevant to these.	blocked as Not 'Exposed' as the pressure is not considered to be relevant to these.
	Death or injury by collision	Broadscale habitat and habitat features were blocked as Not 'Exposed' as the pressure is not considered to be relevant to these.	Non-mobile, non-ovigerous species were considered to be 'Not Sensitive' to this pressure.
Biological pressures	Visual disturbance	Not proposing to assess?	No features were considered to be sensitive to this feature so blocked as 'Not Sensitive'.
	Genetic modification & translocation of indigenous species	Not assessed for broadscale habitat and habitat features as the pressure was not considered relevant.	Assessment was limited to species of relevance Molluscan, crustacean, mussels, oysters, scallops and associated habitats. (Others not exposed)
	Introduction or spread of non-indigenous species	Features that are restricted to deeper waters are blocked as 'Not Exposed' to this pressure 9see Annex C).	
	Introduction of microbial pathogens		Only relevant to oysters and related habitats(Oyster bed biotope SS.SMx.IMx.Ost)., all other features blocked as not sensitive.
	Removal of target species		Primarily relevant to shellfish features and associated habitats. Habitats and species which are not commercially targeted are blocked as not exposed.
	Removal of non-target species	No blocking	

1 Where species occur in one or more broad environments (deepwater, subtidal, intertidal) a sensitivity assessment is made if any of that habitats expose the species to a pressure.
2 Selected pressures only relevant to some feature types

Annex F. Workshop Reports

Workshop Report: Workshop 1
8th/9th July 2010 Northminster House (Natural England) Peterborough

1. Overview

1.1 Project Information

The UK is committed to the establishment of a network of marine protected areas (MPAs) to conserve marine ecosystems and marine biodiversity. The MPA Strategy outlines Government policy on how to create the network and includes the sites that will contribute to the network and the design principles to be used in selecting them.

Defra (in association with the devolved administrations and statutory nature conservation bodies) has funded a research contract (MB0102) to collate relevant biophysical data to support MPA network planning. Under Task 3, the contractor reviewed the current techniques available to assess sensitivity of habitats and species to human pressures.

Building on this review, the current study seeks to develop a matrix through a three stage process that describes the relative sensitivities of a list of key marine habitats and species, including the EUNIS Level 3 broad-scale habitats, OSPAR threatened and/or declining habitats and species and the UK BAP habitats and species, to a series of environmental pressures. The intention is that the matrix will provide sensitivity scores and benchmarks for each feature against a series of environmental pressures. A sensitivity score of 'high', 'medium', 'low' or 'not sensitive' will be assigned for each species and habitat according to its sensitivity to each pressure. Two 'benchmarks' will also be provided for each pressure, where the benchmarks describe the breakpoints between high-medium-low intensity of the pressure. The sensitivity score for each pressure/feature combination (i.e. either a pressure/habitat combination, or a pressure/species combination), will relate to the pressure intensity between the two benchmarks.

A brief technical report will accompany the matrix, and will provide an audit of the decisions made during the workshop. It will detail the methods used to derive the scores and benchmarks within the matrix, the expert and literature sources that were used, and the relative confidence scores for each assessment.

As part of the matrix development ABPmer and MarLIN have organised two, two-day workshops, where experts from research (workshop 1) and industry (workshop 2) are invited to comment on the methodology and pressure benchmarks and to contribute and refine expert-judgement based sensitivity assessments for the draft sensitivity matrix.

This report outlines workshop 1, discussing the aims and achievements of the workshop, and the discussions held and subsequent modifications to pressure benchmarks. The agenda for the workshop is presented in Annex A and a list of represented institutions, is provided in Annex B.

1.2 Workshop Aims and Achievements

This document presents a summary of the workshop component of the project, which was held at Northminster House in Peterborough on the 8th and 9th July 2010. The specific aims of the workshop were to, 1) provide an opportunity for comment on the overall methodology and review and modify pressure benchmarks and 2) provide sensitivity assessments based on expert judgement (supported by evidence where possible as experts had been asked to supply references).

Presentations on the methodology were given by Stephen Hull from ABPmer (on the pressure benchmarks) and Heidi Tillin, also from ABPmer, (sensitivity assessment methodology). Relevant discussion and responses are outlined in Section 2.

2. Workshop Discussions

This session outlines the main responses from delegates to presentations and feedback from the reporting sessions that were held after workshop sessions. These have been ordered below to relate to application of the assessments, pressures and the methodology. Feedback on abrasion benchmarks at the workshop was taken into consideration and a new benchmark was subsequently developed for the sensitivity matrix.

2.1 Application

Stephen Hull from ABPmer outlined some important points that delegates should consider when making assessments regarding the application of the matrix. The first was that the sensitivity score should relate to the pressure benchmark level. When the matrix assessments are applied the level of pressures resulting from activity will be compared with this benchmark to identify whether management measures are required. Secondly, that when used for management the scale of the pressure (exposure) on the feature would be considered. Finally, it was indicated that both recovery and resistance scores and the confidence levels associated with these are recorded and would be supplied separately as part of the final reporting. Resistance scores, (the degree to which a species is tolerant/intolerant of pressures at the benchmark level) are also informative for management. Where resistance is low, then even if overall sensitivity is low (e.g. in circumstances where recovery is judged to be rapid) then there would still be a requirement for management measures to allow recovery to take place.

2.2 Pressure Discussions

Physical Loss & Physical Damage

There was some confusion over the pressure themes in physical loss and physical damage and overlap. Habitat changes in the physical damage pressure were also understood by some delegates to represent habitat loss. The differences between these were made explicit by ABPmer, where habitat loss represents a permanent loss of marine environment to land or freshwater. Marine habitats (locations) where the substrate changes are considered under the *habitat change* theme. The introduction of hard substrates through permanent installations is regarded to represent a habitat change rather than habitat loss.

Abrasion

It was noted that there are a range of abrasion impacts, for example in terms of fishing gears, different types have differing levels of impact. It was therefore suggested that this pressure should be further subdivided to activity categories. It was accepted that this is the case but that for the purposes of the sensitivity matrix (high-level risk assessment) the detail level was too great. It was noted that explicit assessments can cause problems in management and be counter-productive.

Over the course of the workshop delegates raised concerns over the abrasion benchmarks as difficult to apply. These were adopted from Hall *et al*. 2008 - the benchmark for heavy abrasion was 1-2 times a week within an area of 2.5nm x 2.5nm and is not readily translatable into a clear abrasion pressure (which is dependent on width of gear and assumptions about length and direction of tow etc).

Other Physical Pressures

Introduction of Light

It was suggested that macroalgal and plant features may be sensitive to the introduction of light, however it was clarified that this pressure was understood to refer to introduction of artificial light and that this pressure was not considered likely to alter productivity levels/community composition. Therefore the pressures blocking of all features as 'not sensitive' to this pressure would stand in the sensitivity matrix.

Biological Pressures

Removal of Target and Non-Target Species

There was some uncertainty in the breakout sessions as to assessment of the sensitivity to removal of target and non-target species. ABPmer confirmed that the removal of target species pressure identified the sensitivity of the feature to removal as a target species. Therefore if the elements of the feature selected for assessment were not targeted by commercial fisheries they were judged to be 'not sensitive'. For example blue mussel beds are assessed to be sensitive to removal of target species as blue mussels are an integral element of the habitat and are targeted commercially. However, peat and clay habitats are not targeted by commercial fisheries and are therefore 'not sensitive' to this pressure. Where selected elements of the feature were impacted incidentally by commercial fisheries then this sensitivity was assessed under 'removal of non-target species'. This was a pragmatic decision to reflect sensitivity and discriminate between impacted and non-impacted elements, as the first level of a risk assessment. It was felt that community structure changes, e.g. removal of top predators causing population changes in prey species, were too wide ranging and subtle to be captured in a single pressure and associated benchmark and that the evidence base would not, in any case, not be sufficient to support assessments.

2.3 Methodology

In response to questions it was confirmed that the sensitivity matrix applies intertidally.

Broadscale Habitats

For the broadscale habitat features there was some discussion over which constituent biotopes would be used to deliver the assessment. It was confirmed that this had been discussed by the project steering group and that the range of sensitivities would be shown in the matrix. Additional reporting would indicate the biotope types used to form the assessment and any marked sensitivity differences highlighted.

Differentiating community and habitat

Delegates were directed to select the elements of each habitat feature that they would base their assessment on and to be guided by which elements characterise the feature. For example, when assessing peat and clay the habitat (substrate) is critical to defining the habitat. The biological community could be lost but this would be expected to recover, however, loss of peat and clay would represent a permanent alteration of the feature from which it would not be expected to recover.

3. Workshop Sessions

Over the course of the workshop there were five breakout sessions where parallel groups of experts assessed the sensitivity of features. The 108 features had been grouped according to the categories below to allow experts to choose relevant groups. The breakout sessions are shown below in Table 1. As delegates became more experienced in applying the methodology the groups were further subdivided to allow more assessments to be made. Each group was supported by a recorder who had been briefed at a training session prior to the workshop. The role of the recorder was primarily to fill out the audit record sheets (paper or electronic) to capture the expert decisions. Approximately 530 assessments/reviews were made by experts at the workshop.

Table 1: Workshop breakout sessions

Session	Features			
1	Rock	Biogenic Reefs	Sediments	
2	Habitats	Macroalgae	Deep Sea	Biogenic Reefs
3	Rock	Macroalgae	Sediments	Crustaceans
4	Rock	Saltmarsh	Cnidarians	Macroalgae
5	Saline Lagoon	Rock	Molluscs	Seagrass

The following workshop materials were provided to support the groups:

- Pressures benchmarks table
- Methodology
- Step by step simple methodology outline
- Features and biotope table (showing constituent biotopes)
- Audit record sheets specific to each feature (blocked according to matrix) as paper and electronic copies.
- Draft matrices
- Tables of features grouped in to workshop sessions
- Information on resistance and resilience for features from MarLIN (where reviews had been undertaken).

4. References

Stelzenmüller, V., Rogers, S.I., Mills, C.M. 2008. Spatio-temporal patterns of fishing pressure on UK marine landscapes, and their implications for spatial planning and management. ICES Journal of Marine Science, 65: 1081-1091.

Mills, C. M., Townsend, S. E., Jennings, S., Eastwood, P. D., Houghton, C. A. 2007. Estimating high resolution trawl fishing effort from satellite-based vessel monitoring system data. ICES Journal of Marine Science, 64: 248–255.

Annex A - Agenda

Defra MB0102: MPA Sensitivity Matrix Workshop		
Date: 8th & 9th July 2010 **Venue**: Natural England, Northminster House, Peterborough, PE1 1UA		
Agenda Day One		
09:00	**Welcome and Refreshments**	
09:30	Opening: Welcome from Chair	
09:40	Aims of Sensitivity Matrix (Project Steering Group Representative)	Background - Project objectives, Scope, Outputs, Application
10:00	**Questions from Delegates**	
10:05	Pressure Benchmarks (Stephen Hull ABPmer)	Outline of workshop, explanation of the pressure benchmarks, derivation and how these will be used in the sensitivity assessments.
10:40	**Questions from Delegates**	
10:55	**Coffee/Tea available**	
11:10	Workshop Methodology (Heidi Tillin ABPmer)	Briefing on assessment methodology and delegate materials
11:45	**Questions from Delegates**	
12:00	**Lunch**	
12:30	Breakout Session 1	Further details on breakout sessions will be supplied at the workshop.
14:15	Assessment of first session	Brief report on results of first breakout session and opportunity to identify any problems, difficulties arising etc
14:45	**Coffee**	
15:00	Breakout Session 2	Further details on breakout sessions will be supplied at the workshop.
16:45	Reporting back- Breakout session 2.	
17:15	Concluding remarks, brief outline of sessions for following day	

Agenda Day Two		
09:00	**Coffee**	
09:30	Workshop Recap	Summary of previous days sessions and recap on methodology
10:00	Breakout Session 4	Delegates will be assigned to parallel breakout sessions to work on sensitivity assessments in small, expert groups (further details on breakout sessions will be supplied prior to the workshop)
11:30	**Coffee**	
11:45	Brief reporting/addition of assessments to draft matrix	Results of first session and discussion of positive/negative experiences, can anything be changed to facilitate assessments?
12:00	Breakout Session 5	Further details on breakout sessions will be supplied at the workshop
13:30	**Lunch**	
14:00	Breakout Session 6	Further details on breakout sessions will be supplied at the workshop
15:30	Workshop Summary Session	Summary of decisions, progress on matrix and concluding remarks
16:15	Workshop close	

Annex B - Attendance List

Workshop 1 Representatives
ABPmer
Bangor University
Centre for Environment, Fisheries and Aquaculture Science (CEFAS)
Countryside Council for Wales (CCW)
Environment Agency (EA)
Heriot Watt University
Joint Nature Conservation Committee (JNCC)
Marine Biological Association (MBA)
Marine Scotland
Natural England (NE)
Natural History Museum
Northern Ireland Environment Agency
Scottish Association for Marine Science (SAMS)
Scottish Environment Protection Agency (SEPA)

Defra Contract: MB102

Accessing and developing the required biophysical datasets and datalayers for marine Protected Areas network planning and wider marine spatial planning purposes.

Task 3 Development of a Sensitivity Matrix

Workshop Report: Workshop 2
28th/29th July 2010 Nobel House; London

1. Overview

1.1 Project Information

The UK is committed to the establishment of a network of marine protected areas (MPAs) to conserve marine ecosystems and marine biodiversity. The MPA Strategy outlines Government policy on how to create the network and includes the sites that will contribute to the network and the design principles to be used in selecting them.

Defra (in association with the devolved administrations and statutory nature conservation bodies) has funded a research contract (MB0102) to collate relevant biophysical data to support MPA network planning. Under Task 3, the contractor reviewed the current techniques available to assess sensitivity of habitats and species to human pressures.

Building on this review, the current study seeks to develop a matrix through a three stage process that describes the relative sensitivities of a list of key marine habitats and species, including the EUNIS Level 3 broad-scale habitats, OSPAR threatened and/or declining habitats and species and the UK BAP habitats and species, to a series of environmental pressures. The intention is that the matrix will provide sensitivity scores and benchmarks for each feature against a series of environmental pressures. A sensitivity score of 'high', 'medium', 'low' or 'not sensitive' will be assigned for each species and habitat according to its sensitivity to each pressure. Two 'benchmarks' will also be provided for each pressure, where the benchmarks describe the breakpoints between high-medium-low intensity of the pressure. The sensitivity score for each pressure/feature combination (i.e. either a pressure/habitat combination, or a pressure/species combination), will relate to the pressure intensity between the two benchmarks.

A brief technical report will accompany the matrix, and will provide an audit of the decisions made during the workshop. It will detail the methods used to derive the scores and benchmarks within the matrix, the expert and literature sources that were used, and the relative confidence scores for each assessment.

As part of the matrix development ABPmer and MarLIN have organised two, two-day workshops, where experts from research (workshop 1) and industry (workshop 2) were invited to comment on the methodology and pressure benchmarks and to contribute and refine expert-judgement based sensitivity assessments for the draft sensitivity matrix.

This report outlines workshop 2, discussing the aims and achievements of the workshop, and the discussions held and subsequent modifications to pressure benchmarks. The agenda for the workshop is presented in Annex A and a listing of participants, with affiliations, is provided in Annex B. The full powerpoint version of each presentation is attached in Annex C.

1.2 Workshop Aims and Achievements

This document presents a summary of the workshop component of the project, which was held at Nobel House in London on the 28th and 29th July 2010. The specific aims of the workshop were to, 1) provide an opportunity for comment on the overall methodology and review and modify pressure benchmarks and 2) provide sensitivity assessments based on expert judgement (supported by evidence where possible as experts had been asked to supply references).

Presentations on the methodology (see Annex C) were given by Stephen Hull from ABPmer (on the pressure benchmarks) and Heidi Tillin, also from ABPmer, (sensitivity assessment methodology). Relevant discussion and responses are outlined in Section 2.

2. Workshop Discussions

This session outlines the main responses from delegates to presentations and feedback from the reporting sessions that were held after workshop sessions. These have been ordered below to relate to application of the assessments, pressures and the methodology. Feedback on abrasion benchmarks at the workshop was taken into consideration and a new benchmark was subsequently developed for the sensitivity matrix.

2.1 Management and Further Use of Outputs

Some delegates were unhappy with the project and felt that it was designed wrongly and did not address the needs of industry. It was clarified to delegates that the request for the project came from the regional projects to Defra. The sensitivity matrix approach was adopted because stakeholders do not know the implications of designation. The matrix should therefore provide information for stakeholders regarding the management implications of decisions and their basis. Users should be aware of resistance score as in some cases recovery will not occur, or in the case of repeated activities, recovery may not be happening and resistance could be declining.

Delegates raised a number of issues around the way that the matrix would be used to inform management and the future use of outputs. Although it was indicated that these issues were to a large extent outwith the scope of the workshops it was recognised that these were legitimate concerns regarding the process and they are therefore recorded here.

In summary the main issues relating to management and future use of outputs were:

- Sensitivity Matrix and Management- How matrix assessments will be used to inform management and roles of different bodies.
- Involvement of stakeholders
- Timetables

Several delegates raised concerns over the future interpretation of the sensitivity assessments. When the matrix is 'out there' then there is no control over its use and that assessments may be used for management measures etc., by people without understanding of the underlying caveats around the assessments and limitations on its use. ABPmer indicated that they could not answer questions on or dictate the future process, they could only produce guidance on the use of the matrix in the final technical report.

Members of the project steering group confirmed that the matrix was being taken to the regional projects, and that the matrix is not the end point. For each MCZ, different levels of protection will be set out based on site specific decisions that will involve stakeholder consultation.

2.2 Sensitivity Matrix and Management

Delegates questioned what the sensitivity ranks mean for management. ABPmer confirmed that where a higher risk to the feature from pressures is indicated (e.g. higher sensitivity), taking into account the scale of the activity to the scale of the feature, then management measures were more likely to be required.

There were some questions on the role of various agencies/bodies in management and implementation. Clarification was provided where possible by members of the project steering group. However, it should be noted that there are some unresolved points such as timescales and future development which have not yet been agreed.

It was confirmed that the matrix will be released to regional projects with guidance on use and the limitations of this. Given the specific nature of measures, the interpretations will need to be taken forward on site level. Each of the four regional projects will have to interpret in their own way. Of particular importance is that implementation takes into account the scale of the feature and the scale of the activity, this spatial scale is most appropriately dealt with at the individual site level.

2.3 Involvement of Stakeholders

Stakeholders felt that they were not being engaged or involved in the use of the outputs and the development of related outputs- in particular the pressures/activities matrix. Some raised concerns that they were in effect being asked to tick boxes (which usually returned a medium sensitivity) and then having to blindly trust that they will be engaged in future application that was relevant to the sectors they represent.

Industry experts indicated that they were not happy to make assessments without knowing what management measures will be put in place.

2.4 Benchmarks

On the second day clarification was provided by members of the project steering group on the rationale for adopting a pressures/ benchmark based approach. This was to ensure a greater, useful, longevity for the matrix. Activities change over time, so adopting a pressures based approach rather than an activities approach is considered desirable. It is recognised that the benchmarks are difficult to set and that overall the project is developing benchmarks to take to regional projects. It is recognised that it is not a perfect tool, and that there are information gaps when linking pressures to sensitivities and activities to pressures

Abrasion Benchmarks

The pressure 'abrasion' caused the most concern for delegates who were unhappy that gears that could cause different levels of damage to benthic habitats were lumped together e.g. otter trawls with beam trawls and scallop dredges. In addition it was felt that the benchmarks for the abrasion pressures were too low to represent a medium level of pressure.

ABPmer acknowledged these concerns and had flagged up the abrasion benchmark as presenting difficulties in the opening presentation. It was explained that the benchmarks had been changed following the preceding workshop and that we able to change the benchmarks based on feedback but were reluctant to alter the number of pressure categories. In formulating the benchmarks we were trying to move away from an 'operations likely to damage' approach and had been encouraged to look at frequency, intensity to benchmark. If frequencies were causing problems for delegates then a proposed solution was to avoid intensity assessments in the benchmarks and move back towards an operations likely to damage approach, e.g. scallop dredges, would be judged to lead to heavy abrasion whether the intensity is once a year or 100 times a year. Clarification was sought from senior members of the project on behalf of delegates that it was possible to change the benchmarks, it was agreed that this was possible where it was felt that this would make them more realistic for regional projects.

The Proposed Benchmarks that were developed at this meeting are outlined below (NB this may be subject to some changes in descriptive terms):

- Light Abrasion (surface damage/Light Damage): defined as damage to surface features, seabed (e.g. surface growing algae).
- Medium Abrasion (shallow damage/Medium Damage) : shallow damage to surface (e.g. <25 mm in sediment, scoring of surface of hard substrates.
- Heavy abrasion (deep damage/High damage): structural damage to seabed (e.g. upheaval of rocks, deep penetration into sediments or rock).

Again the importance of the spatial scale of effects was emphasised and that this should be taken into account via the activities x pressures matrix. For example a large anchor might deeply penetrate the substrate, leading to a large impact but that this effect would be extremely localised.

2.5 Water Flow and Wave Exposure Changes

Delegates also made the point that, with regard to water flow and wave exposure changes in relation to climate change, that these parameters are very variable anyway. It was considered by some experts that it is not sensible to worry about predicted changes when there is such huge variability anyway.

2.6 Methodology

There were some concerns that there is a lack of discrimination in the sensitivity assessments resulting from the combination on resistance and resilience scales. Specifically that most assessments came out as ‘medium’. It was pointed out that the overall reporting will also include information on the basal resistance and resilience scores.

2.7 Timescales

Delegates raised concerns over the timetable of the project. In particular some delegates expressed a reluctance to be involved if there was little or no time to make assessments. In this line concern was raised over whether the overriding project goal was to get scientific community to assess sensitivity and confidence of judgements or to get the project done in timeframe?

It was pointed out that the matrix was not just dependent on assessments made at the workshop but had also been informed by the first workshop, a separate Plymouth workshop as well as project group knowledge. Where there is uncertainty it will be noted. The matrix is not deterministic, it is the first stage and it will be possible for more information to feed into the matrix.

3. Workshop Sessions

Table 1: Workshop breakout sessions: expert groups

Day 1 – 28 July 2010	Group 1	Group 2	Group 3	Group 4
Breakout Session 1 12:30-14:15	Sediment	Rock	Biogenic Reefs/Maerl	Deep Sea
Breakout Session 1 Feedback 14:15-15:00	Discussion of breakout session 1.			
Breakout Session 2 15:00-16:45	Abrasion pressure benchmark discussion group and further expert input to sensitivity assessments.			
Day 2 – 29 July 2010	Pressure benchmark discussion (15 delegates)			

The following workshop materials were provided to support the groups during breakout sessions:

- Pressures benchmarks table
- Methodology
- Step by step simple methodology outline
- Features and biotope table (showing constituent biotopes)
- Tables showing constituent Eunis level 4 and 5 biotopes for the broadscale habitats

- Audit record sheets specific to each feature (blocked according to matrix) as paper and electronic copies.
- Draft matrices
- Tables of features grouped in to workshop sessions
- Information on resistance and resilience for features from MarLIN (where reviews had been undertaken).

Following breakout session 1 a number of delegates felt that they were unable to contribute further to the sensitivity matrices, due to lack of knowledge of the resistance and resilience of features, and subsequently left the workshop. The remaining delegates were invited to remain and contribute to further sensitivity assessments if they felt they had sufficient expert knowledge of the feature, or were invited to join a discussion group on pressure benchmarks (specifically physical abrasion), which delegates had indicated that they wished to discuss.

During the breakout sessions on Day 1, a number of sensitivity assessments were completed with experts: seagrass, Ostrea edulis, sediments. On Day 2, the pressure benchmark discussion was continued with a subset of delegates who had expressed a wish to return and continue this discussion. No further sensitivity assessments were conducted on Day 2.

Annex A - Agenda

Defra MB0102: MPA Sensitivity Matrix Workshop 2		
Date: 28th & 29th July 2010 Venue: Defra, Nobel House, 17 Smith Square, London. SW1P 3JR.		
Agenda Day One		
09:00	Welcome and Refreshments: Room 807	
09:30	Opening: Welcome from Chair: Room 807	
09:40	Aims of Sensitivity Matrix (Project Steering Group Representative)	Background - Project objectives, Scope, Outputs, Application
10:00	Questions from Delegates	
10:05	Pressure Benchmarks (Stephen Hull ABPmer)	Outline of workshop, explanation of the pressure benchmarks, derivation and how these will be used in the sensitivity assessments.
10:40	Questions from Delegates	
10:55	Coffee/Tea available: Room 807	
11:10	Workshop Methodology (Heidi Tillin ABPmer)	Briefing on assessment methodology and delegate materials
11:45	Questions from Delegates	
12:00	Lunch: Room 807	
12:30	Breakout Session 1 Rooms 307,401,406 & 409	Delegates to self-select into smaller groups, based on features, to develop sensitivity assessments (see Table below on workshop sessions).
14:15	Assessment of first session: Room 807	Brief report on results of first breakout session and opportunity to identify any problems, difficulties arising etc
14:45	Coffee: Room 807	
15:00	Breakout Session 2 Rooms 307,401,406 & 409	Delegates to self-select into smaller groups, based on features, to develop sensitivity assessments (see Table below on workshop sessions).
16:45	Reporting back- Breakout session 2: Room 807	
17:15	Concluding remarks, brief outline of sessions for following day: Room 807	

Agenda Day Two		
09:00	Coffee: Conference Room B	
09:30	Workshop Recap: Conference Room B	Summary of previous days sessions and recap on methodology
10:00	Breakout Session 4 Rooms 301,401,406 & 409	Delegates to select breakout sessions (see Table below) to work on sensitivity assessments in small groups.
11:30	Coffee: Room 210 Ergon House	
11:45	Breakout Session 5: Rooms 301,401,406 & 409	Delegates to select breakout sessions (see Table below) to work on sensitivity assessments in small groups.
13:30	Lunch: Room 210 Ergon House	
14:00	Breakout Session 6: Rooms 301,401,406 & 409	Delegates to select breakout sessions (see Table below) to work on sensitivity assessments in small groups.
15:30	Workshop Summary Session Conference Room B	Summary of decisions, progress on matrix and concluding remarks
16:15	Workshop close: Conference Room B	

Annex B - Representative List

ABPmer
British Marine Aggregate Producers Association
British Marine Federation
British Shipping
CCW
Centrica
International Power plc
Joint Nature Conservation Committee (JNCC)
Mainstream
MALSF
Marine Ecological Surveys Ltd
Marine Management Organisation
MarLIN
Maritime and coastguard agency
MPA Fishing Coalition
Natural England (NE)
Net Gain Project
NFFO
Oil and Gas UK
Proudman Oceanographic Research Laboratory
Renewable Energy Association
Renewable UK
RES
Royal Institute of Chartered Surveyors (RICS)
RPS Group
RWE npower
SEAEnergy Renewables
SeaFish
The Crown Estate
UK Cable Protection Committee
UK Major Ports Group
Wildlife Trust

Annex G. MCZ/MPA Feature Sensitivity Proformas

Table 1: Broad-scale habitats

Broad-scale habitat types	**Annex G Section**
High energy intertidal rock	G1.1
Moderate energy intertidal rock	G1.2
Low energy intertidal rock	G1.3
Intertidal coarse sediment	G1.4
Intertidal sand and muddy sand	G1.5
Intertidal mud	G1.6
Intertidal mixed sediments	G1.7
Coastal saltmarshes and saline reedbeds	G1.8
Intertidal sediments dominated by aquatic angiosperms	G1.9
Intertidal biogenic reefs	G1.10
High energy infralittoral rock	G1.11
Moderate energy infralittoral rock	G1.12
Low energy infralittoral rock	G1.13
High energy circalittoral rock	G1.14
Moderate energy circalittoral rock[§] G1.15	
Low energy circalittoral rock[§] G1.16	
Subtidal coarse sediment	G1.17
Subtidal sand	G1.18
Subtidal mud	G1.19
Subtidal mixed sediments	G1.20
Subtidal macrophyte-dominated sediment	G1.21
Subtidal biogenic reefs	G1.22
Deep-sea bed	G1.23
Deep-sea rock and artificial hard substrata	G1.24
Deep-sea mixed substrata	G1.25
Deep-sea sand	G1.26
Deep-sea muddy sand	G1.27
Deep-sea mud	G1.28
Deep-sea bioherms	G1.29
Raised features of the deep-sea bed	G1.30
Deep-sea trenches and canyons, channels, slope failures and slumps on the continental slope	G1.31
Vents, seeps, hypoxic and anoxic habitats of the deep sea	G1.32

Table 2: Rare, threatened or declining habitats

Habitats of conservation importance	**Annex G Section**
Blue Mussel beds (including intertidal beds on mixed and sandy sediments)	G2.1
Burrowed mud	G2.2
Carbonate reefs	G2.3
Coastal saltmarsh	G2.4
Cold-water coral reefs	G2.5
Coral carbonate mounds	G2.6
Coral Gardens	G2.7
Deep-sea sponge aggregations	G2.8
Egg wrack beds	G2.9
Estuarine rocky habitats	G2.10
File shell beds	G2.11
Flame shell beds	G2.12
Fragile sponge & anthozoan communities on subtidal rocky habitats	G2.13
Intertidal mudflats	G2.14
Intertidal underboulder communities	G2.15
Inshore deep mud with burrowing heart urchins	G2.16
Kelp and seaweed communities on sublittoral sediment	G2.17
Littoral chalk communities	G2.18
Maerl beds	G2.19
Maerl or coarse shell gravel with burrowing sea cucumbers	G2.20
Horse mussel (*Modiolus modiolus*) beds	G2.21
Mud habitats in deep water	G2.22
Musculus discors beds	G2.23
Northern seafan communities	G2.24
Saline lagoons	G2.25
Sea-pen and burrowing megafauna communities	G2.26
Ostrea edulis beds	G2.27
Peat and clay exposures	G2.28
Sabellaria alveolata reefs	G2.29
Sabellaria spinulosa reefs	G2.30
Seagrass beds	G2.31
Seamounts G2.32	
Serpulid reefs	G2.33
Shallow tideswept coarse sands with burrowing bivalves	G2.34
Sheltered muddy gravels	G2.35
Submarine structures made by leaking gases	G2.36
Subtidal chalk	G2.37
Subtidal mixed muddy sediments	G2.38
Subtidal sands and gravels	G2.39
Tideswept algal communities	G2.40
Tide-swept channels	G2.41

Table 3: Species of conservation interest

Scientific name	**Common name**	**Annex G Section**
Alcyonium hibernicum	Pink soft coral	G3.1
Alkmaria romijni	Tentacled lagoon-worm	G3.2
Amphianthus dohrnii	Sea-fan anemone	G3.3
Anotrichium barbatum	Bearded red seaweed	G3.4
Arachnanthus sarsi	Burrowing Sea Anemone	G3.5
Arctica islandica	Ocean quahog	G3.6
Armandia cirrhosa	Lagoon sandworm	G3.7
Atrina pectinata	Fan mussel	G3.8
Caecum armoricum	Defolin`s lagoon snail	G3.9
Cruoria cruoriaeformis	Red seaweed	G3.10
Dermocorynus montagnei	Red seaweed	G3.11
Edwardsia timida	Timid burrowing anemone	G3.12
Eunicella verrucosa	Pink sea-fan	G3.13
Gammarus insensibilis	Lagoon sand shrimp	G3.14
Gitanopsis bispinosa	Amphipod shrimp	G3.15
Glossus humanus	Heart cockle	G3.16
Gobius cobitis	Giant goby	G3.17
Gobius couchi	Couch's goby	G3.18
Haliclystus auricular	Stalked jellyfish	G3.19
Hippocampus guttulatus	Long snouted seahorse	G3.20
Hippocampus hippocampus	Short snouted seahorse	G3.21
Leptometra celtica	Feather star	G3.22
Leptopsammia pruvoti	Sunset cup coral	G3.23
Lithothamnion corallioides	Coral maërl	G3.24
Lucernariopsis campanulata	Stalked jellyfish	G3.25
Lucernariopsis cruxmelitensis	Stalked jellyfish	G3.26
Mitella pollicipes	Gooseneck barnacle	G3.27
Nematostella vectensis	Starlet sea anemone	G3.28
Ostrea edulis	Native oyster	G3.29
Padina pavonica	Peacock’s tail	G3.30
Palinurus elephas	Spiny lobster	G3.31
Paludinella littorina	Sea snail	G3.32
Parazoanthus anguicomus	White cluster anemone	G3.33
Phymatolithon calcareum	Common maërl	G3.34
Tenellia adspersa	Lagoon sea slug	G3.35
Victorella pavida	Trembling sea mat	G3.36

1.1 High energy intertidal rock

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - This broadscale habitat is defined by high energy conditions(water flow and wave exposure) and is therefore judged to be not sensitive to the pressure benchmark.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1. This feature was judged to be not sensitive to changes in emergence regime at the pressure benchmark, as the lower limit of the constituent biotopes is not set by the high water mark. This assessment assumes that the component species populations of biotopes will be able to shift their habitat ranges in response to relatively gradual changes in sea level. Over time the characteristic zones of the shore communities will change height on the shore in response. Sensitivity would be greater where the upper levels of the shore are steeper (e.g. sea wall rather than natural shore so that the intertidal extent is reduced. This would be expected to reduce species abundance, biological diversity and ecosystem function- however this element of sensitivity is site specific).
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NS	(L1)	1 - This broadscale habitat is defined by high energy conditions(water flow and wave exposure) and is therefore judged to be not sensitive to the pressure benchmark.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(NS-H6)	(L1)	6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Blue mussel beds (see Annex G, Section 2.1), *Mitella pollicipes* Gooseneck barnacle (see Annex G, Section 3.27), Horse mussel beds (see annex G, Section 2.21), *Anotrichium barbatum* Bearded red seaweed (see Annex G, Section 3.4), *Cruoria cruoriaeformis* Red seaweed (see Annex G, Section 3.10), *Dermocorynus montagnei* Red seaweed (see Annex G, Section 3.11), Intertidal under boulder communities (see Annex G, Section 2.15).
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS-H6)	(L1)	6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Blue mussel beds (see Annex G, Section 2.1), *Mitella pollicipes* Gooseneck barnacle (see Annex G, Section 3.27), Horse mussel beds (see annex G, Section 2.21), *Anotrichium barbatum* Bearded red seaweed (see Annex G, Section 3.4), *Cruoria cruoriaeformis* Red seaweed (see Annex G, Section 3.10), *Dermocorynus montagnei* Red seaweed (see Annex G, Section 3.11), Intertidal under boulder communities (see Annex G, Section 2.15).
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - This broadscale habitat is defined by high energy conditions(water flow and wave exposure) and is therefore judged to be not sensitive to the pressure benchmark.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(NS-M6)	(L1)	6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Blue mussel beds (see Annex G, Section 2.1), *Mitella pollicipes* Gooseneck barnacle (see Annex G, Section 3.27), Horse mussel beds (see annex G, Section 2.21), *Anotrichium barbatum* Bearded red seaweed (see Annex G, Section 3.4), *Cruoria cruoriaeformis* Red seaweed (see Annex G, Section 3.10), *Dermocorynus montagnei* Red seaweed (see Annex G, Section 3.11), Intertidal under boulder communities (see Annex G, Section 2.15).

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NS	(L1)	1 - This broadscale habitat is defined by high energy conditions(water flow and wave exposure) and is therefore judged to be not sensitive to the pressure benchmark.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(M4)	(L4)	(M4)	(L4)	(NS-H6)	(L4)	4 - based on expert judgement from workshop 1 6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Blue mussel beds (see Annex G, Section 2.1), Mitella pollicipes Gooseneck barnacle (see Annex G, Section 3.27), Horse mussel beds (see annex G, Section 2.21), Anotrichium barbatum Bearded red seaweed (see Annex G, Section 3.4), Cruoria cruoriaeformis Red seaweed (see Annex G, Section 3.10), Dermocorynus montagnei Red seaweed (see Annex G, Section 3.11), Intertidal under boulder communities (see Annex G, Section 2.15).
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - The effects of organic enrichment on high energy rocky shores are predicted to lead to any impacts, this feature is therefore judged to be not sensitive.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(L4)	(M4)	(L4)	(M-H6)	(L4)	4 - based on expert judgement from workshop 1; Southward *et al.* (1978) 6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Blue mussel beds (see Annex G, Section 2.1), Mitella pollicipes Gooseneck barnacle (see Annex G, Section 3.27), Horse mussel beds (see annex G, Section 2.21), Anotrichium barbatum Bearded red seaweed (see Annex G, Section 3.4), Cruoria cruoriaeformis Red seaweed (see Annex G, Section 3.10), Dermocorynus montagnei Red seaweed (see Annex G, Section 3.11), Intertidal under boulder communities (see Annex G, Section 2.15).
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H10)	(L10)	(M-H 10)	(L10)	(NS-L10)	(L10)	1 - This broadscale habitat is defined by areas of high energy (water flow and wave exposure) and is therefore judged to have high resistance to the pressure benchmark as deposits would be rapidly removed by the prevailing hydrodynamic regime. The low sensitivity assessment relates to scour effects on sensitive species such as red algae. Recovery is predicted to be rapid from the low level of effects (<2 years).One characterising biotope (A1.127) of this broad-scale habitat also has an infaunal component (piddocks on eulittoral fossilised peat) and reviewers raised concerns that these may be smothered. Recovery is predicted to be rapid from the low level of effects (<2 years).

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(M9)	(L9)	(H9)	(L9)	(L9)	(L9)	Effects would arise through deposition and scour particuarly on red algae and upper shore communities and smothering would lead to mortality of some organisms. Deposits in tide pools may not be readily removed and organisms may be unable to escape burial and mortality. However, recovery would be judged to be high.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N10)	(L10)	(L-M10)	(L10)	(M-H10)	(L10)	10 - high energy intertidal rock communities are characterised by attached sessile organisms, these will have no resistance to penetration and disturbance of the substratum, where this is interpreted as removal of habitat. However this feature is subject to naturally high levels of physical disturbance and recovery is predicted to be medium.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N10)	(L10)	(L-M10)	(L10)	(M-H10)	(L10)	10 - high energy intertidal rock communities are characterised by attached sessile organisms, these will have no resistance to penetration and disturbance of the substratum, where this is interpreted as removal of habitat. However this feature is subject to naturally high levels of physical disturbance and recovery is predicted to be medium.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M10)	(L10)	(M10)	(L10)	(M10)	(L10)	10 - high energy intertidal rock communities are characterised by attached sessile organisms, these will have low resistance to surface abrasion however mortality is judged as likely to be lower than for subsurface abrasion and penetration pressures. As the feature is subject to naturally high levels of physical disturbance (highly dynamic environment) and characterised by common species with planktonic dispersal of propagules recovery is predicted to be medium.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N10)	(L10)	(L-M10)	(L10)	(M-H10)	(L10)	1 - Based on penetration/disturbance assessment.
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS-M6)	(L1)	6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Blue mussel beds (see Annex G, Section 2.1), Mitella pollicipes Gooseneck barnacle (see Annex G, Section 3.27), Horse mussel beds (see annex G, Section 2.21), Anotrichium barbatum Bearded red seaweed (see Annex G, Section 3.4), Cruoria cruoriaeformis Red seaweed (see Annex G, Section 3.10), Dermocorynus montagnei Red seaweed (see Annex G, Section 3.11), Intertidal under boulder communities (see Annex G, Section 2.15).

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-H1)	(L1)	(M-H1)	(L1)	(NS-H1)	(L1)	1 - highest energy biotopes unlikely to exposed to significant INS; lower energy biotopes have low resistance but would generally be expected to recover fairly rapidly
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - possible target fishery for littorinids in some biotopes
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H1)	(L1)	(H1)	(L1)	(NS-H1)	(L1)	1 - Selective extraction of littorinids may not affect wider assemblage depending on factors such as trampling, intensity etc

1.2 Moderate energy intertidal rock

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS-M1)	(L1)	1. The constituent biotopes of this broadscale habitat feature are predicted to generally have low or no sensitivity to changes in the pressure benchmark as they occur in moderately exposed locations which may experience high levels of wave action periodically. The feature includes intertidal underboulder communities which have been assessed in this project as not sensitive to this pressure at the pressure benchmark (Annex G2.15). The medium sensitivity relates to fucoid assemblages and piddocks in peat and clay where the pressure change may exceed tolerances resulting in changes in habitat suitability and erosion of substrate and .

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1. This feature was judged to be not sensitive to changes in emergence regime at the pressure benchmark, as the lower limit of the constituent biotopes is not set by the high water mark. This assessment assumes that the component species populations of biotopes will be able to shift their habitat ranges in response to relatively gradual changes in sea level. Over time the characteristic zones of the shore communities will change height on the shore in response. Sensitivity would be greater where the upper levels of the shore are steeper (e.g. sea wall rather than natural shore so that the intertidal extent is reduced. This would be expected to reduce species abundance, biological diversity and ecosystem function- however this eleement of sensitivity is site specific).
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS-M1)	(L)	1. The constituent biotopes of this broadscale habitat feature are predicted to generally have low or no sensitivity to changes in the pressure benchmark as they occur in moderately exposed locations which may experience high levels of wave action periodically. The feature includes intertidal underboulder communities which have been assessed in this project as not sensitive to this pressure at the pressure benchmark (Annex G2.15). The assessment is informed by constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10-not sensitive), Peat and clay exposures (Annex G 2.28-low sensitivity), Intertidal under boulder communities (see Annex G, section 2.15-not sensitive), Blue mussel beds (see Annex G, Section 2.1-medium sensitivity).
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(L6)	(L1)	6 - The assessment is based on relevant habitat feature assessments; Estuarine rocky habitats (see Annex G, Section 2.10-low sensitivity), Intertidal under boulder communities (see Annex G, section 2.15-low) and Blue mussel beds (see Annex G, Section 2.1-low sensitivity)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
...al changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS-L1)	(L1)	6 - The assessment is based on relevant habitat feature assessments; Estuarine rocky habitats (see Annex G, Section 2.10-low sensitivity), Intertidal under boulder communities (see Annex G, section 2.15-low sensitivity), peat and clay exposures (see Annex G, Section 2.18-not sensitive), Blue mussel beds (see Annex G, Section 2.1-not sensitive).
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS-M1)	(L1)	1. The constituent biotopes of this broadscale habitat feature are predicted to generally have low or no sensitivity to changes in the pressure benchmark as they occur in moderately exposed locations which may experience high levels of wave action periodically. The assessment is informed by constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10-not sensitive), Peat and clay exposures (Annex G 2.28-low sensitivity), Intertidal under boulder communities (see Annex G, section 2.15-not sensitive), Blue mussel beds (see Annex G, Section 2.1-medium sensitivity).
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(L-M6)	(L1)	6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Intertidal under boulder communities (see Annex G, section 2.15), littoral chalk communities (see Annex G, Section 2.18), Blue mussel beds (see Annex G, Section 2.1)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrologic	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS-M1)	(L1)	1. The constituent biotopes of this broadscale habitat feature are predicted to generally have low or no sensitivity to changes in the pressure benchmark as they occur in moderately exposed locations which may experience high levels of wave action periodically. The feature includes intertidal underboulder communities which have been assessed in this project as not sensitive to this pressure at the pressure benchmark (Annex G2.15). The medium sensitivity relates to fucoid assemblages and piddocks in peat and clay where the pressure change may exceed tolerances resulting in changes in habitat suitability and erosion of substrate. - The assessment is informed by constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10-not sensitive), Peat and clay exposures (Annex G 2.28-low sensitivity), Intertidal under boulder communities (see Annex G, section 2.15-not sensitive), Blue mussel beds (see Annex G, Section 2.1-medium sensitivity).
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS6)	(L)	6 - The assessment is based on relevant habitat feature assessments; Estuarine rocky habitats (see Annex G, Section 2.10-), peat and clay exposures (see Annex G, Section 2.18-not sensitive), Blue mussel beds (see Annex G, Section 2.1-low sensitivity)
l changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemica	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS6)	(L1)	6 - The assessment is based on relevant habitat feature assessments; Estuarine rocky habitats (see Annex G, Section 2.10-not sensitive), Intertidal under boulder communities (see Annex G, section 2.15-not sensitive), peat and clay exposures (see Annex G, Section 2.18-not sensitive), Blue mussel beds (see Annex G, Section 2.1-not sensitive)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M-H6)	(L1)	6 - The assessment is based on relevant habitat feature assessments; Estuarine rocky habitats (see Annex G, Section 2.10medium-), Intertidal under boulder communities (see Annex G, section 2.15-medium sensitivity), peat and clay exposures (see Annex G, Section 2.18-high sensitivity), Blue mussel beds (see Annex G, Section 2.1-high sensitivity)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H10)	(L10)	(M-H 10)	(L10)	(NS-L10)	(L10)	1 - This broadscale habitat is defined by areas of moderate energy (water flow and wave exposure) and is therefore judged to have high resistance to the pressure benchmark as deposits would be removed by the prevailing hydrodynamic regime. The low sensitivity assessment relates to scour effects on sensitive species such as red algae. Recovery is predicted to be rapid from the low level of effects (<2 years).

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(L-H6)	(L1)	6 - Based on assessments of relevant habitats; Estuarine rocky habitats (see Annex G, Section 2.10-low sensitivity), Peat and clay exposures (Annex G 2.28- low sensitivity)Intertidal underboulder communities (see Annex G, section 2.15-Medium) and blue mussel beds (Annex G 2.1- High)and informed by expert review (medium sensitivity considering all biotopes).
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N10)	(L10)	(L-M10)	(L10)	(M-H10)	(L10)	10 - Based on external expert review: the pressure is interpreted as subsurface damage to habitat with epifauna and flora having no resistance and recovery being low to medium (between 2-25 years).
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N10)	(L10)	(L-M10)	(L10)	(M-H10)	(L10)	10 - Based on external expert review: the pressure is interpreted as subsurface damage to habitat with epifauna and flora having no resistance and recovery being low to medium (between 2-25 years).
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M10)	(L10)	(M10)	(L10)	(M10)	(L10)	10 - High energy intertidal rock communities are characterised by attached sessile organisms, these will have low resistance to surface abrasion however mortality is judged as likely to be lower than for subsurface abrasion and penetration pressures. As the feature is subject to naturally high levels of physical disturbance (highly dynamic environment) and characterised by common species with planktonic dispersal of propagules recovery is predicted to be medium.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N10)	(L10)	(L-M10)	(L10)	(M-H10)	(L10)	10 - Based on external expert review: the pressure is interpreted as subsurface damage to habitat with epifauna and flora having no resistance and recovery being low to medium (between 2-25 years).
sures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical press	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Other physical press	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Other physical press	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Other physical press	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS-M6)	(L1)	6 - The assessment is based on relevant habitat feature assessments; Estuarine rocky habitats (see Annex G, Section 2.10-medium), Intertidal under boulder communities (see Annex G, section 2.15-not sensitive), peat and clay exposures (see Annex G, Section 2.18-not sensitive), Blue mussel beds (see Annex G, Section 2.1-not sensitive)
Biological pressures	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-M1)	(L1)	(M-H1)	(L1)	(L-M1)	(L1)	1 - most biotopes likely to exposed to significant INS but would be expected to recover fairly rapidly
Biological pressures	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - possible target fishery for littorinids in some biotopes
Biological pressures	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Selective extraction of littorinids may not affect wider assemblage depending on factors such as trampling, intensity etc

1.3 Low energy intertidal rock

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS-H6)	(L1)	6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Egg wrack beds (see Annex G, Section 2.9)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1. This feature was judged to be not sensitive to changes in emergence regime at the pressure benchmark, as the lower limit of the constituent biotopes is not set by the high water mark. This assessment assumes that the component species populations of biotopes will be able to shift their habitat ranges in response to relatively gradual changes in sea level. Over time the characteristic zones of the shore communities will change height on the shore in response. Sensitivity would be greater where the upper levels of the shore are steeper (e.g. sea wall rather than natural shore so that the intertidal extent is reduced. This would be expected to reduce species abundance, biological diversity and ecosystem function- however this element of sensitivity is site specific).

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(L-H1)	(L1)	(L-H1)	(L1)	(NS-H6)	(L1)	1 Sensitivity to changes in wave exposure at the pressure benchmark will vary, some constituent biotopes are characterised by macroalgae species that occur on shores that are moderately exposed and these are judged to be not sensitive to change at the pressure benchmark (see EUNIS classification). However, some species occur only in very sheltered conditions and sensitivity may be high based on the assessments made for Egg wrack beds (see Annex G, Section 2.9)
Hydrological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(L-H6)	(L1)	6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Egg wrack beds (see Annex G, Section 2.9)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS-L6)	(L1)	6 -Constituent biotopes contain species that occur across a range of salinities and hence this broadscale habitat is judged to have no to low sensitivity to changes at the pressure benchmark.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS-H6)	(L1)	6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Egg wrack beds (see Annex G, Section 2.9)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(M6)	(L1)	6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Egg wrack beds (see Annex G, Section 2.9)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(L-H1)	(L1)	(L-H1)	(L1)	(NS-H6)	(L1)	1 Sensitivity to changes in wave exposure at the pressure benchmark will vary, some constituent biotopes are characterised by macroalgae species that occur on shores that are moderately exposed and these are judged to be not sensitive to change at the pressure benchmark (see EUNIS classification). However, some species occur only in very sheltered conditions and sensitivity may be high based on the assessments made for Egg wrack beds (see Annex G, Section 2.9)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS6)	(L1)	6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Egg wrack beds (see Annex G, Section 2.9)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(L4)	(H4)	(L4)	(NS4) (NS-H6)	(L1)	4 - based on expert judgement from workshop 1; This level of organic enrichment would change the community composition of the biotope but it would not change the classification of the habitat type 6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Egg wrack beds (see Annex G, Section 2.9)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(L4)	(L4)	(L4)	(H4)	(L1)	4 - based on expert judgement from workshop 1
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(NS-H6)	(L1)	6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Egg wrack beds (see Annex G, Section 2.9)
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(M-H6)	(L1)	6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Egg wrack beds (see Annex G, Section 2.9)
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N10)	(L10)	(L-M10)	(L10)	(M-H10)	(L10)	10 - based on external expert review: the pressure is interpreted as removal of habitat with epifauna and flora having no resistance and recovery being low to medium (between 2-25 years).Species with low recovery times include Ascophyllum nodosum (Jenkins et al. 2004).
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N10)	(L10)	(L-M10)	(L10)	(M-H10)	(L10)	10 - based on external expert review: the pressure is interpreted as leading to removal of habitat with epifauna and flora having no resistance and recovery being low to medium (between 2-25 years).Species with low recovery times include Ascophyllum nodosum (Jenkins et al. 2004).
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(N10)	(L10)	(L-M10)	(L10)	(M-H10)	(L10)	10 - based on external expert review: the pressure is interpreted as leading to removal of habitat with epifauna and flora having no resistance and recovery being low to medium (between 2-25 years).Species with low recovery times include Ascophyllum nodosum (Jenkins et al. 2004).
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N10)	(L10)	(L-M10)	(L10)	(M-H10)	(L10)	10 - based on external expert review: the pressure is interpreted as leading to removal of habitat with epifauna and flora having no resistance and recovery being low to medium (between 2-25 years).Species with low recovery times include Ascophyllum nodosum (Jenkins et al. 2004).
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS-M6)	(L1)	6 - based on constituent biotopes; Estuarine rocky habitats (see Annex G, Section 2.10), Egg wrack beds (see Annex G, Section 2.9)
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-M1)	(L1)	(M-H1)	(L1)	(L-M1)	(L1)	1 - most biotopes likely to exposed to significant INS but would be expected to recover fairly rapidly
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - possible target fishery for littorinids in some biotopes
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - selective extraction of littorinids may not affect wider assemblage depending on factors such as trampling, intensity etc

1.4 Intertidal coarse sediment

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(L-H6)	(L1)	6 - based on constituent biotopes
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS-M6)	(L1)	6 - based on constituent biotopes, this broadscale habitat feature includes estuarine biotopes that are adapted to salinity fluctuations, some range shifts in species may occur in response to salinity changes and sensitivity was therefore assessed as ranging from none to medium.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NS	(L1)	1 - Not Sensitive to this pressure benchmark; Water clarity changes would be unlikely to affect the habitat type or the associated (sparse) biological assemblage however some sub-lethal evffects may occur.
lution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pol	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS1)	(L1)	1 - This feature experiences short-term high level depositions of organic matter which is utilised by fauna which may be present only while this material is present, this feature is therefore judged to be not sensitive to the pressure benchmark(see MarLIN LS.LGS.Sh.Pec).
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N1)	(L1)	(H1)		(M1)	(L1)	1 - Due to the sparse fauan and high reproductive potential of the characterising species Pectenogammarus planicrurus (if potnetial recruits are available, recovery would be predicted to be rapid.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M10)	(L10)	(H10)	(L10)	(L10)	(L10)	10: This habitat was reviewed as part of the external review- the assessment was based on all component biotopes (see EUNIS classification).
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(M10)	(L10)	(H10)	(L10)	(L10)	(L10)	10: This habitat was reviewed as part of the external review- the assessment was based on all component biotopes (see EUNIS classification).
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(H10)	(L10)	(H10)	(H10)	(NS10)	(L10)	10 - This feature was assessed as 'not sensitive' as part of the external review, with all component biotopes taken into consideration (see EUNIS classification). The feature is considered to be subject to periodic levels of high disturbance e.g. winter storms and the sparse fauna is predicted to be either able to resist such event or recover rapidlly.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(H10)	(L10)	(H10)	(H10)	(NS10)	(L10)	10 this assessment was based on that made by expert judgement for the penetration pressure. High abrasion was considered to be less damaging and the feature was considered unlikely to be more sensitive to this pressure than pentration/disturbance.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(H10)	(L10)	(H10)	(H10)	(NS10)	(L10)	10 this assessment was based on that made by expert judgement for the penetration pressure. Light abrasion was considered to be less damaging and the feature was considered unlikely to be more sensitive to this pressure than pentration/disturbance.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N1)	(L1)	(H1)	(L1)	(M1)	(L1)	1 - Substrate extraction would remove much of the sparse fauna but this is predicted to recover rapidlly.
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS1)	(L1)	1 - Feature does not contain oysters.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - No records of significant INS impacts in these habitats
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(NE1)	(H1)	1 - No comercial harvesting in these habitats
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(NE1)	(H1)	1 - No commercial harvesting in these habitats

1.5 Intertidal sand and muddy sand

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(H6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
Hydrological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(L6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(M6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(M6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M10)	(L10)	(M10)	(L10)	(M10)	(L10)	10 - assessment as part of external review supported a medium assessment based on all constituent biotopes (EUNIS classification).

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L10)	(L10)	(M10)	(L10)	(M10)	(L10)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14) 10 - assessment as part of external review supported a medium assessment based on all constituent biotopes (EUNIS classification).
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L10)	(L10)	(M10)	(L10)	(M10)	(L10)	10 - assessment as part of external review supported a medium assessment based on *Mytilis* biotope and muddy gravels.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(M6)	(H6)	(H6)	(H6)	(L6)	(H6)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M6)	(H6)	(H6)	(H6)	(L6)	(H6)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(L10)	(L10)	(M10)	(L10)	(M10)	(L10)	10 - assessment as part of external review supported a medium assessment based on *Mytilis* biotope and muddy gravels.
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1- some of the component biotopes (strandline and mobile biotopes) likely to have high resistance and resilience - no records of significant INS impacts in these habitats; other biotopes possibly more sensitive
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1 - unlikely that commercial harvesting would be occurring in these biotopes except for A2.242 (Cerastoderma) for which impacts well documented
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1 - unlikely that commercial harvesting would be occurring in these biotopes except for A2.242 (Cerastoderma) for which impacts well documented

1.6 Intertidal mud

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(H6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
ore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L4)	(H4)	(H4)	(H4)	(M3) (L4)	(H4)	3 - Refer to Marlin evidence, Annex H, Section 2.11 4 - based on expert judgement from workshop 1 ; Fawley power station papers, discharge studies Medway As the project specification was to develop an expert judgement based approach we have presented the workshop assessment in the matrix, however compared with MarLIN's evidence based approach, this may underestimate sensitivity.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L4)	(H4)	(H4)	(H4)	(M3) (L4) (L5)	(H4)	3 - Refer to Marlin evidence, Annex H, Section 2.11 4 - based on expert judgement from workshop 1 5 - Based on expert judgement from external review As the project specification was to develop an expert judgement based approach we have presented the workshop assessment in the matrix, however compared with MarLIN's evidence based approach, this may underestimate sensitivity.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (insh	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H4)	(H4)	(H4)	(H4)	(M3) (NS4) (NS5)	(H4)	3 - Refer to Marlin evidence, Annex H, Section 2.11 4 - based on expert judgement from workshop 1 ; Severn barrage studies 5 - Based on expert judgement from external review As the project specification was to develop an expert judgement based approach we have presented the workshop assessment in the matrix, however compared with MarLIN's evidence based approach, this may underestimate sensitivity.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(M3)	(L1)	3 - Refer to Marlin evidence, Annex H, Section 2.11
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(M3)	(L1)	3 - Refer to Marlin evidence, Annex H, Section 2.11
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS3) (NS5)	(L1)	3 - Refer to Marlin evidence, Annex H, Section 2.11 5 - Based on expert judgement from CCW
:hemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other c	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(M4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1; Medway study on algal blooms, Southern water in Portsmouth harbour
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H6)	(L1)	6 - based on constituent biotopes; Intertidal mudflats (see Annex G, Section 2.14)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L4)	(H4)	(H4)	(H4)	(L4)	(H4)	4 - based on expert judgement from workshop 1; work on EIAs for windfarms - cables through intertidal mudflats
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(H4)	(H4)	(H4)	(L4)	(H4)	4 - based on expert judgement from workshop 1; work on EIAs for windfarms - cables through intertidal mudflats
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(M4)	(H4)	(H4)	(H4)	(L4)	(H4)	4 - based on expert judgement from workshop 1; Thames cockle dredging, Kent and Essex 20 year sensitivity surveys
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(H4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(H4)	(H4)	(M4) (H5)	(H4)	4 - based on expert judgement from workshop 1 5 - Based on expert judgement from CCW

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
...ssures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS1)	(L1)	1 - Not Sensitive to this pressure benchmark, not Ostrea edulis habitat.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pres	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M-H1) (M4)	(L1) (H4)	(VL-H1) (VL4)	(L1) (H4)	(M-NS1) (M4)	(L1) (H4)	1 - no records of significant INS impacts for A2.31; A2.323 can be dominated by Marenzelleria; unlikely that oysters would penetrate a long way up estuaries 4 - based on expert judgement from workshop 1 ; studies in Essex on Pacific oysters (plus Holland, France, Exe estuary)
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1) (L4)	(L1) (H4)	(H1) (M4)	(L1) (H4)	(NS1) (M4)	(L1) (H4)	1- none of these features targeted directly, possible harvesting of shrimp? 4 - based on expert judgement from workshop 1 ; Gordon Watson et al 2007
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1 ; Fowler 2001

1.7 Intertidal mixed sediments

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(NS6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)
Hydrological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(NS6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(M6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(M6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M10)	(L10)	(M10)	(L10)	(M6) (M10)	(L10)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35) 10 - assessment as part of external review supported a medium assessment based on component habitats, especially poorly sorted muddy gravels, as it is not though that escape rates of many speies allow for escape from 5cm of sediment.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L10)	(L10)	(L10)	(L10)	(H6) (H10)	(L10)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35) 10 - assessment as part of external review supported a medium assessment based on intertidal muddy gravels.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L-M10)	(L10)	(L-M10)	(L10)	(M-H10)	(L10)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35); 10 -assessment was based on external review and considers all component biotopes (EUNIS classification), although expert indicated that the medium level of sensitivity was probably most likely.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(M-H6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(M6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(H6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)
es	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressure	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS1)	(L1)	1 - Not oyster habitat
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M6)	(L1)	6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35); all of the biotopes could be affected by INS to some extent
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L-H1)	(L1)	(M-H1)	(L1)	(L-M 1) (M6)	(L1)	1 - features not targeted directly, except possible Cerastoderma (A2.421); possibly harvesting of shrimp 6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M1)	(L1)	(M1)	(L1)	(M1) (M6)	(L1)	1 - commercial harvesting methods likely to remove non-target species in significant quantities. Evidence from e.g. cockle fisheries, scallop dredging 6 - based on constituent biotopes; Sheltered muddy gravels (see Annex G, Section 2.35)

1.8 Coastal saltmarshes and saline reedbeds

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(M6)	(L1)	6 - based on constituent biotopes; Coastal saltmarsh (see Annex G, Section 2.4)
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M6)	(L1)	6 - based on constituent biotopes; Coastal saltmarsh (see Annex G, Section 2.4)
(inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NS	(L)	6 - based on constituent biotopes; Coastal saltmarsh (see Annex G, Section 2.4)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(M6)	(L1)	6 - based on constituent biotopes; Coastal saltmarsh (see Annex G, Section 2.4)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(M6)	(L1)	6 - based on constituent biotopes; Coastal saltmarsh (see Annex G, Section 2.4)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(M6)	(L1)	6 - based on constituent biotopes; Coastal saltmarsh (see Annex G, Section 2.4)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS6)	(L1)	6 - based on constituent biotopes; Coastal saltmarsh (see Annex G, Section 2.4)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; Leuche et al 1998. Are effects but deemed to be positive so given high resistance score
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N1)	(L1)	(VL4)	(H4)	(H1)	(L4)	1 - Resistance based on no resistance to change in substrate, recoverability scores based on other workshop assessments.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - based on expert judgement from workshop 1
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1; Garbutt and Boorman 2009. Studies from realignment projects, Bangor University
pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical p	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(H1)	(M1)	(M1)	(M1)	(M1)	1 - Spartina anglica highly invasive and may dominate marsh community
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - based on expert judgement from workshop 1
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(NE4)	(H1)	4 - based on expert judgement from workshop 1

1.9 Intertidal sediments dominated by aquatic angiosperms

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s	(M7)	(M7)	(VL7)	(M7)	(M7)	(M7)	7 - based on expert judgement from workshop 2; scientific papers on reroduction of seagrass beds. Assume cannot remove pressure of climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100	(M7)	(M7)	(VL7)	(M7)	(M7)	(M7)	7 - based on expert judgement from workshop 2; scientific papers on reroduction of seagrass beds
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H6) (M6)	(H6) (L6)	(H6) (M6)	(H6) (L6)	(NS-M6)	(H6)	6 - Based on the seagrass habitat assessments (Annex G 2.31), as these are a constituent biotope of this feature.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London	(N7)	(M6)	(VL6)	(M6)	(H6)	(M6)	6 - Based on the seagrass habitat assessments (Annex G 2.31), as these are a constituent biotope of this feature.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(M6)	(L6)	(VL6)	(L6)	(M6)	(L6)	6 - Based on the seagrass habitat assessments (Annex G 2.31), habitat sensitivty was assessed as high
re/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H6)	(M6)	(H6)	(M6)	(NS6)	(M6)	6 - Based on the seagrass habitat assessments (Annex G 2.31).
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(H6)	(M6)	(H6)	(M6)	(NS6)	(M6)	6 - Based on the seagrass habitat assessments (Annex G 2.31), as these are a constituent biotope of this feature.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H6) (M6)	(H6) (L6)	(H6) (M6)	(H6) (L6)	(NS-M6)	(H6)	6 - Based on the seagrass habitat assessments (Annex G 2.31), as these are a constituent biotope of this feature.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshor	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(M6)	(M6) (L6)	(L6) (H6) (M6)	(M6) (L6)	(L-M6)	(M6)	6 - Based on the seagrass habitat assessments (Annex G 2.31), as these are a constituent biotope of this feature.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(M6)	(L6)	(VL6)	(L6)	(M6)	(L6)	6 - Based on the seagrass habitat assessments (Annex G 2.31), as these are a constituent biotope of this feature.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(VL6) (L6) (M6)	(M6) (L6)	(VL6) (H6) (M6)	(M6) (L6)	(L-H6)	(M6) (L6)	6 - Based on the seagrass habitat assessments (Annex G 2.31), as these are a constituent biotope of this feature.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status	(M6)	(M6)	(M6)	(M6)	(M6)	(M6)	6 - Based on the seagrass habitat assessments (Annex G 2.31), as these are a constituent biotope of this feature.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H6) (M6)	(M6)	(H6) (M6)	(M6)	(NS-M6)	(M6)	6 - Based on the seagrass habitat assessments (Annex G 2.31), as these are a constituent biotope of this feature.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(H6) (M6)	(M6)	(H6) (M6)	(M6)	(NS-M6)	(M6)	6 - Based on the seagrass habitat assessments (Annex G 2.31), as these are a constituent biotope of this feature.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N6)	(H6)	(VL6)	(H6)	(H1) (H6)	(H6)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater 6 - based on constituent biotopes, seagrass beds (G2.31)
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(VL-M6) (M10)	(L6) (L10)	(VL-H6) (M10)	(L6) (L10)	(L-H6) (M10)	(L6) (L10)	6 - based on constituent biotopes, seagrass beds (see Annex G, Section 2.31) 10 - This assessment was supported by external review which was based on component biotopes, assuming some complete smothering of seagrass even by 5 cm of fines as the lay on the surface of the sea bed at low tide. Also low energy environment so that removal of sediment would not be rapid and that respiration through roots would be restricted.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N6) (N10)	(L6) (L10)	(L-M6) (L10)	(L6) (L10)	(M-H6) (H10)	(L6) (L10)	6 - based on constituent biotopes, seagrass beds (see Annex G, Section 2.31) 10 - This assessment was supported by external review
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N6)	(M-H6)	(VL-L6)	(L6)	(H6)	(M6)	6 - based on constituent biotopes, seagrass beds (see Annex G, Section 2.31)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N6)	(H6)	(L6)	(H6)	(H6)	(H6)	6 - based on constituent biotopes, seagrass beds (see Annex G, Section 2.31)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L-M6)	(M6)	(M-H6)	(L-M6)	(L-M6)	(L-M6)	6 - based on constituent biotopes, seagrass beds (see Annex G, Section 2.31)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N6)	(M-H6)	(VL-L6)	(L6)	(H6)	(M6)	6 - based on constituent biotopes, seagrass beds (see Annex G, Section 2.31)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological p	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M6)	(L6)	(M6)	(L6)	(M-H6)	(L6)	1) Based on the seagrass habitat assessments (Annex G 2.31), as these are a constituent biotope of this feature.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H6)	(H6)	(H6)	(H6)	(NS1)	(H6)	1 - biotope features not targted directly
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L6)	(H6)	(L6)	(H6)	(H6)	(H6)	6 - based on constituent biotopes, seagrass beds (see Annex G, Section 2.31)

1.10 Intertidal biogenic reefs

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS-M6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(L-H6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1). The high assessment is based on Sabellaria alveolata reefs, which apart from the Severn Estuary are intertidal features and hence would be impacted by a rise in sea level which would affect intertidal populations. Sensitivity may be mediated by: shoreline topography if this allows a range expansion up-shore in response or restricts this; on biological interactions and other prevailing environmental conditions.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M-H6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(L-H6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)
al)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/loca	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS-M6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(M6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(M-H6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS-L6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS1)	(L1)	1 - Not Sensitive to this pressure benchmark; The constituent biotopes Sabellaria and Mytilis edulis are not judged to be sensitive to organic enrichment at the pressure benchmark level.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(NS-H6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(NS-L6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(L-H6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N10)	(L10)	(L-M10)	(N10)	(M-H6) (M-H10)	(L10)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1); 10- assessment made during external review, considering all constituent biotopes where Medium sensitivty relates to mussels on sediment and high refers to *Sabellaria* on rocks.
	Shallow abrasion/penetration: damage to seabed surface and penetration ≤25mm	Damage to seabed surface and penetration ≤25mm					(M-H6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(L-M6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(M-H6)	(L1)	6 - based on constituent biotopes; Sabellaria alveolata reefs (see Annex G, Section 2.29), Blue mussel beds (see Annex G, Section 2.1)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
…ressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological p	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1- S alveolata not sensitive, mussel biotopes sensitive
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(N-H1)	(M1)	(L-M1)	(M1)	(NS-M1)	(M1)	1 - S alveolata not sensitive, mussels sensitive
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(N-L1)	(M1)	(L-M1)	(M1)	(M-H1)	(M1)	

1.11 High energy infralittoral rock

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - This broadscale habitat is defined by areas of high energy (water flow and wave exposure) and is therefore judged to be not sesntivie to the pressure benchmark.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS1)	(L1)	1 - This broadscale habitat is defined by areas of high energy (water flow and wave exposure) and is therefore judged to be not sesntivie to the pressure benchmark.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L-M1)	(L1)	(H-M1)	(L1)	(L-M1)	(L1)	1. Resistance was assessed as medium to low on the basis that the characterising biotopes occur in full salinity and would be sensitive to changes in salinity (particularly decreases). Most species characterising the biotopes that constitute this broadscale salinity are relatively short-lived and recovery was judged to take between 2-10 years

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - This broadscale habitat is defined by areas of high energy (water flow and wave exposure) and is therefore judged to be not sesntivie to the pressure benchmark.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS1)	(L1)	1 - This broadscale habitat is defined by areas of high energy (water flow and wave exposure) and is therefore judged to be not sesntivie to the pressure benchmark.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(L-M1)	(L1)	(M-H1)	(L1)	(L-M1)	(L1)	1. This broadscale feature as an infralittoral habitat is characterised by photosynthetic organisms (macroalgae), it is assumed therefore that this habitat is found in locations where water clarity allows light penetration and photosynthesis. A change in clarity that leads to a decrease in light penetration would inhibit photosynthesis. Species tolerances would vary (red algae can photosynthesis at lower levels) so that sensitivity would vary for characterising biotopes. It was judged that resistance would be low to medium and that recovery would be high-medium (from 1-10 years)
...anges	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical cha	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS1)	(L1)	1 - Organic enrichment is not predicted to impact high energy infralittoral rock,this feature is therefore judged to be not sensitive.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H1)	(L1)	1 - Feature would be highly sensitive to a change in seabed type
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H10)	(L10)	(H10)	(L10)	(NS1) (NS10)	(L1) (L10)	1 - This broadscale habitat is defined by areas of high energy (water flow and wave exposure) and is therefore judged to be not sensitive to the pressure benchmark as deposits would be rapidly removed by the prevailing hydrodynamic regime. 10 - This assessment was supported by external review that considered all component biotopes (EUNIS classification)
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(M-H10)	(L10)	10 - This assessment was supported by external review that considered all component biotopes (EUNIS classification)
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(M1)	(L1)	1 - Based on assessments made for moderate energy infralittoral rock, as both characterised by epiflora with similiarities in species and life histories

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(M1)	(L1)	1 - Based on assessments made for moderate energy infralittoral rock, as both characterised by epiflora with similiarities in species and life histories
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(M1)	(L1)	1 - Based on assessments made for moderate energy infralittoral rock, as both characterised by epiflora with similiarities in species and life histories
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(M1)	(L1)	1 - Based on assessments made for moderate energy infralittoral rock, as both characterised by epiflora with similiarities in species and life histories
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS1)	(L1)	1 - Not Ostrea edulis habitat
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M-H1)	(L1)	(M-H1)	(L1)	(NS-L1)	(L1)	1 - constituent biotopes likely to be exposed to INS but unlikely to dominate fauna/flora. Higher energy biotopes may recover more quickly as likely to be less affected.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L1)	(M1)	(M1)	(M1)	(M1)	(M1)	1 - possible harvesting of kelp
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1)	(M1)	(M1)	(L1)	(M1)	(L1)	1 - Kelp holdfast assemblages may only recover fairly slowly

1.12 Moderate energy infralittoral rock

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - Feature occurs at exposed and very exposed locations- not judged to be sensitive to pressure benchmark
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS1)	(L1)	1 - Feature occurs at exposed and very exposed locations- not judged to be sensitive to pressure benchmark
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(M-H1)	(L1)	(M-H1)	(L1)	(L-M1)	(L1)	1. Assessment based on assessment made at workshop 1 for kelps and other seaweeds on sublittoral sediment as this feature contains these species. Some constituent biotopes within this feature are characterised by variable salinity and would be predicted to have some resistance to salinity changes at the benchmark level. However these changes may exceed tolerances and other assemblages may be more sensitive to salinity changes, a precautionary assessment of low has therefore been entered as part of the range.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - Feature occurs at exposed and very exposed locations- not judged to be sensitive to pressure benchmark
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS1)	(L1)	1 - Feature occurs at exposed and very exposed locations- not judged to be sensitive to pressure benchmark
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(L-M1)	(L1)	(M-H1)	(L1)	(L-M1)	(L1)	1. This broadscale feature as an infralittoral habitat is characterised by photosynthetic organisms (macroalgae), it is assumed therefore that this habitat is found in locations where water clarity allows light penetration and photosynthesis. A change in clarity that leads to a decrease in light penetration would inhibit photosynthesis. Species tolerances would vary (red algae can photosynthesis at lower levels) so that sensitivity would vary for characterising biotopes. It was judged that resistance would be low to medium and that recovery would be high-medium (from 1-10 years)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS1)	(L1)	1 - Not sensitive - water movements will remove excess organic matter.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Recoverability based on elements including Laminaria hyperborea;
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H10)	(L10)	(H10)	(L10)	(NS1) (NS10)	(L1)	1 - Not sensitive- water movements will remove deposited fine materials, although some short-term sublethal effects may occur- e.g. reduction in photosynthesis. This assessment was supported by external review (10) where the assessment was based on consideration of all component biotopes (EUNIS classification).

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(M-H10)	(L1)	1 - Not sensitive- water movements will remove deposited fine materials, although some short-term sublethal effects may occur- e.g. reduction in photosynthesis
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N1)	(L1)	(M1)	(L1)	(M1) (M-H10)	(L1)	
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N1)	(L1)	(M1)	(L1)	(M1)	(L1)	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS1)	(L1)	1 - Not Ostrea edulis habitat
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - constituent biotopes could be subject to significant INS impacts.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L1)	(M1)	(M1)	(M1)	(M1)	(M1)	1 - possible harvesting of kelp
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1)	(M1)	(M1)	(L1)	(M1)	(L1)	1 - Kelp holdfast assemblages may only recover fairly slowly

1.13 Low energy infralittoral rock

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100						(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - Although low energy the feature was not predicted to be sensitivie to changes at the pressure benchmark
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS1)	(L1)	1 - Not sensitive at the pressure benchmark as feature contains elements that are exposed to storm surges etc.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(M-H1)	(L1)	(L-H1)	(L1)	(L-M1)	(L1)	1. Assessment based on assessment made at workshop 1 for kelps and other seaweeds on sublittoral sediment as this feature contains these species. Some constituent biotopes within this feature are characterised by variable salinity and would be predicted to have some resistance to salinity changes at the benchmark level. However these changes may exceed tolerances and other assemblages may be more sensitive to salinity changes. Recovery of Ascophyllum nodosum can be very slow >12 years (Jenkins et al. 2004) -so resilience was assessed as low for biotopes characterised by this species.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS1)	(L1)	1 - Not sensitive at the pressure benchmark as feature contains elements that are exposed to storm surges etc.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(L-M1)	(L1)	(L-H1)	(L1)	(L-H1)	(L1)	1. This broadscale feature as an infralittoral habitat is characterised by photosynthetic organisms (macroalgae), it is assumed therefore that this habitat is found in locations where water clarity allows light penetration and photosynthesis. A change in clarity that leads to a decrease in light penetration would inhibit photosynthesis. Species tolerances would vary (red algae can photosynthesis at lower levels) so that sensitivity would vary for characterising biotopes. It was judged that resistance would be low to medium and that recovery would be high-medium (from 1-10 years) for most biotopes Recovery of Ascophyllum nodosum can be very slow >12 years (Jenkins et al. 2004) -so resilience was assessed as low for biotopes characterised by this species.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS1)	(L1)	1 - Rock shore not predicted to be sensitive to the level of organic enrichment, some water movements would occur that would remove particles, may encourage some growth of ephemeral elements.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M-H6)	(L1)	
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M10)	(L10)	(H10)	(L10)	(L10)	(L10)	10 - Some constituent biotopes heavily silted, others exposed to wave action/surges and fine deposits would be rapidly removed. Resistance will depend on the length of time that the feature is smothered by the deposit, the medium resistance is based on smothering of understory alga features and mussel beds in low energy environments.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(M1)	(L1)	(M1)	(M-H1)	(M1) (M-H10)	(L1)	1 - Resistance will depend on the length of time that the feature is smothered by the deposit, in lower energy environments deposits will not be removed and the resistance was judged to be medium
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(M1) (M-H10)	(L1)	
	Shallow abrasion/penetration: damage to seabed surface and penetration ≤25mm	Damage to seabed surface and penetration ≤25mm					(M1) (M-H10)	(L1)	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(M1)	(L1)	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(M1)	(L1)	

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS1)	(L1)	1 - Not Ostrea edulis habitat

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological press	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1 - constituent biotopes could be subject to significant INS impacts, assessed as medium sensitivity. A3.73 unlikely to be significantly affected, assessed as not sensitive
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L1)	(M1)	(L-M1)	(M1)	(M-H1)	(M1)	1 - possible harvesting of kelp. Other biotopes may not be exposed to pressure, recovery of Ascophyllum nodosum can be very slow >12 years (Jenkins et al. 2004) -so resilience was assessed as low for biotopes characterised by this species.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1)	(M1)	(M1)	(L1)	(M1)	(L1)	1 - Kelp holdfast assemblages may only recover fairly slowly

1.14 High energy circalittoral rock

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	Assessed as part of initial blockfilling of matrix.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - This broadscale habitat is defined by areas of high energy (water flow and wave exposure) and is therefore judged to be not sesntivie to the pressure benchmark.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS1)	(L1)	1 - This broadscale habitat is defined by areas of high energy (water flow and wave exposure) and is therefore judged to be not sesntivie to the pressure benchmark.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(NS-H6)	(L1)	6 - Based on assessments for relevant habitat and species features; Fragile sponge and anthozoan communities on subtidal rocky habitat (see Annex G, Section 2.13-medium sensitivity), Eunicella verrucosa (see Annex G, Section 3.13-not sensitive), Northern sea fan communities (see Annex G, Section 2.24- high sensitivity)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(H6)	(L1)	6 - Based on assessments for relevant habitat and species features; Fragile sponge and anthozoan communities on subtidal rocky habitat (see Annex G, Section 2.13-high sensitivity) and Eunicella verrucosa (see Annex G, Section 3.13-not exposed).
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - This broadscale habitat is defined by areas of high energy (water flow and wave exposure) and is therefore judged to be not sesntivie to the pressure benchmark.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS1)	(L1)	1 - This broadscale habitat is defined by areas of high energy (water flow and wave exposure) and is therefore judged to be not sensitive to the pressure benchmark.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS-H6)	(L1)	6 - Based on assessments for relevant habitat and species features; Fragile sponge and anthozoan communities on subtidal rocky habitat (see Annex G, Section 2.13-not sensitive), Eunicella verrucosa (see Annex G, Section 3.13-high sensitivity), Northern sea fan communities (see Annex G, Section 2.24- not sensitive)
	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical changes	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS6)	(L1)	6 - Based on assessments for relevant habitat and species features; Fragile sponge and anthozoan communities on subtidal rocky habitat (see Annex G, Section 2.13-not sensitive), Eunicella verrucosa (see Annex G, Section 3.13-not sensitive), Northern sea fan communities (see Annex G, Section 2.24- not sensitive)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M-H6)	(L1)	6 - Based on constituent biotopes; Fragile sponge and anthozoan communities on subtidal rocky habitat (see Annex G, Section 2.13-high sensitivity), Eunicella verrucosa (see Annex G, Section 3.13-high sensitivity), Northern sea fan communities (see Annex G, Section 2.24-medium sensitivity)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(M-H6)	(L1)	6 - Based on assessments for relevant habitat and species features; Fragile sponge and anthozoan communities on subtidal rocky habitat (see Annex G, Section 2.13-high sensitivity), Eunicella verrucosa (see Annex G, Section 3.13-high sensitivity), Northern sea fan communities (see Annex G, Section 2.24- medium sensitivity)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(M-H6) (M-H10)	(L1)	6 - Based on assessments for relevant habitat and species features; Fragile sponge and anthozoan communities on subtidal rocky habitat (see Annex G, Section 2.13-high sensitivity), Eunicella verrucosa (see Annex G, Section 3.13-high sensitivity), Northern sea fan communities (see Annex G, Section 2.24- medium sensitivity). Assessment supported by external review
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(M-H6)	(L1)	6 - Based on assessments for relevant habitat and species features; Fragile sponge and anthozoan communities on subtidal rocky habitat (see Annex G, Section 2.13-high sensitivity), Eunicella verrucosa (see Annex G, Section 3.13-high sensitivity), Northern sea fan communities (see Annex G, Section 2.24- medium sensitivity)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(M-H6)	(L1)	6 - Based on assessments for relevant habitat and species features; Fragile sponge and anthozoan communities on subtidal rocky habitat (see Annex G, Section 2.13-high sensitivity), Eunicella verrucosa (see Annex G, Section 3.13-high sensitivity), Northern sea fan communities (see Annex G, Section 2.24- medium sensitivity)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(M-H6)	(L1)	6 - Based on assessments for relevant habitat and species features; Fragile sponge and anthozoan communities on subtidal rocky habitat (see Annex G, Section 2.13-high sensitivity), Eunicella verrucosa (see Annex G, Section 3.13-high sensitivity), Northern sea fan communities (see Annex G, Section 2.24- medium sensitivity)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(M-H6)	(L1)	6 - Based on assessments for relevant habitat and species features; Fragile sponge and anthozoan communities on subtidal rocky habitat (see Annex G, Section 2.13-high sensitivity), Eunicella verrucosa (see Annex G, Section 3.13-high sensitivity), Northern sea fan communities (see Annex G, Section 2.24- medium sensitivity)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS6)	(L1)	6 - based on constituent biotopes; Fragile sponge and anthozoan communities on subtidal rocky habitat (see Annex G, Section 2.13), Eunicella verrucosa (see Annex G, Section 3.13), Northern sea fan communities (see Annex G, Section 2.24)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1 - constituent biotopes could be subject to significant INS impacts, assessed as medium sensitivity. A3.73 unlikely to be significantly affected, assessed as not sensitive
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L1)	(M1)	(M1)	(M1)	(M1)	(M1)	1 - possible harvesting of kelp. Other biotopes may not be exposed to pressure
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1)	(M1)	(M1)	(L1)	(M1)	(L1)	1 - Kelp holdfast assemblages may only recover fairly slowly

1.15 Moderate energy circalittoral rock

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - This broadscale habitat is defined by areas of moderate energy (water flow and wave exposure) and is therefore judged to be not sensitive to the pressure benchmark.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS-M6)	(L1)	6 - based on constituent biotopes; Northern seafan communities (see Annex G, Section 2.24), Fragile sponge and anthozoan communities on subtidal rocky habitats (see Annex G, Section 2.13-medium sensitivity), Sabellaria spinulosa reefs (see Annex G, Section 2.30-not sensitive), Blue mussel beds (see Annex G, Section 2.1-medium sensitivity), Musculus discors beds (see Annex G, Section 2.23 not exposed)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(NS-H6)	(L1)	6 - based on constituent biotopes; Northern seafan communities (see Annex G, Section 2.24), Fragile sponge and anthozoan communities on subtidal rocky habitats (see Annex G, Section 2.13-medium sensitivity), Sabellaria spinulosa reefs (see Annex G, Section 2.30-not sensitivie), Blue mussel beds (see Annex G, Section 2.1-low sensitivity), Musculus discors beds (see Annex G, Section 2.23-not sensitive)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L-H1)	(L1)	6 - based on constituent biotopes; Northern seafan communities (see Annex G, Section 2.24), Fragile sponge and anthozoan communities on subtidal rocky habitats (see Annex G, Section 2.13-high sensitivity), Sabellaria spinulosa reefs (see Annex G, Section 2.30), Blue mussel beds (see Annex G, Section 2.1-not sensitive), Musculus discors beds (see Annex G, Section 2.23-medium sensitivity)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - This broadscale habitat is defined by areas of moderate energy (water flow and wave exposure) and is therefore judged to be not sensitive to the pressure benchmark.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS-M6)	(L1)	6 - based on constituent biotopes; Northern seafan communities (see Annex G, Section 2.24), Fragile sponge and anthozoan communities on subtidal rocky habitats (see Annex G, Section 2.13), Sabellaria spinulosa reefs (see Annex G, Section 2.30), Blue mussel beds (see Annex G, Section 2.1), Musculus discors beds (see Annex G, Section 2.23)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS-H6)	(L1)	6 - based on constituent biotopes; Northern seafan communities (see Annex G, Section 2.24), Fragile sponge and anthozoan communities on subtidal rocky habitats (see Annex G, Section 2.13-not sensitive), Sabellaria spinulosa reefs (see Annex G, Section 2.30-not sensitive), Blue mussel beds (see Annex G, Section 2.1-low sensitivity), Musculus discors beds (see Annex G, Section 2.23-high sensitivity)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical loss	Organic enrichment	100gC/m²/yr					(NS6)	(L1)	6 - based on constituent biotopes; Northern seafan communities (see Annex G, Section 2.24), Fragile sponge and anthozoan communities on subtidal rocky habitats (see Annex G, Section 2.13), Sabellaria spinulosa reefs (see Annex G, Section 2.30), Blue mussel beds (see Annex G, Section 2.1), Musculus discors beds (see Annex G, Section 2.23)-all not sensitive
	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M-H6)	(L1)	6 - based on constituent biotopes; Northern seafan communities (see Annex G, Section 2.24), Fragile sponge and anthozoan communities on subtidal rocky habitats (see Annex G, Section 2.13-high sensitivity), Sabellaria spinulosa reefs (see Annex G, Section 2.30-high sensitivity), Blue mussel beds (see Annex G, Section 2.1-medium sensitivity), Musculus discors beds (see Annex G, Section 2.23)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(NS-H6)	(L1)	6 - based on constituent biotopes; Northern seafan communities (see Annex G, Section 2.24-medium sensitivity), Fragile sponge and anthozoan communities on subtidal rocky habitats (see Annex G, Section 2.13-high sensitivity), Sabellaria spinulosa reefs (see Annex G, Section 2.30-not sensitive), Blue mussel beds (see Annex G, Section 2.1-low sensitivity), Musculus discors beds (see Annex G, Section 2.23-high sensitivity)
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(M-H6)	(L1)	6 - based on constituent biotopes; Northern seafan communities (see Annex G, Section 2.24-medium sensitivity), Fragile sponge and anthozoan communities on subtidal rocky habitats (see Annex G, Section 2.13-high sensitivity), Sabellaria spinulosa reefs (see Annex G, Section 2.30-medium sensitivity), Blue mussel beds (see Annex G, Section 2.1-high sensitivity), Musculus discors beds (see Annex G, Section 2.23-high sensitivity)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(M-H6)	(L1)	6 - based on constituent biotopes; Northern seafan communities (see Annex G, Section 2.24-medium sensitivity), Fragile sponge and anthozoan communities on subtidal rocky habitats (see Annex G, Section 2.13-high sensitivity), Sabellaria spinulosa reefs (see Annex G, Section 2.30-high sensitivity), Blue mussel beds (see Annex G, Section 2.1-medium sensitivity), Musculus discors beds (see Annex G, Section 2.23-high sensitivity)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(M-H6)	(L1)	6 - based on constituent biotopes; Northern seafan communities (see Annex G, Section 2.24-high sensitivity), Fragile sponge and anthozoan communities on subtidal rocky habitats (see Annex G, Section 2.13-high sensitivity), Sabellaria spinulosa reefs (see Annex G, Section 2.30-high sensitivity), Blue mussel beds (see Annex G, Section 2.1-medium sensitivity), Musculus discors beds (see Annex G, Section 2.23-high sensitivity)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(L-H6)	(L1)	6 - based on constituent biotopes; Northern seafan communities (see Annex G, Section 2.24), Fragile sponge and anthozoan communities on subtidal rocky habitats (see Annex G, Section 2.13-high sensitivity), Sabellaria spinulosa reefs (see Annex G, Section 2.30-low sensitivity), Blue mussel beds (see Annex G, Section 2.1-medium sensitivity), Musculus discors beds (see Annex G, Section 2.23-medium sensitivity)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(M-H6)	(L1)	6 - based on constituent biotopes; Northern seafan communities (see Annex G, Section 2.24-medium sensitivity), Fragile sponge and anthozoan communities on subtidal rocky habitats (see Annex G, Section 2.13-high sensitivity), Sabellaria spinulosa reefs (see Annex G, Section 2.30-high sensitivity), Blue mussel beds (see Annex G, Section 2.1-medium sensitivity), Musculus discors beds (see Annex G, Section 2.23-high sensitivity)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
res	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS1)	(L1)	1 - Not Ostrea edulis habitat

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressur	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M-H1)	(L1)	(L-M1)	(L1)	1 - Some INS could occur in these biotopes but may not dominate assemblage
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(M-H1)	(H1)	(M-H1)	(H1)	(NS-M1)	(H1)	1 - removal of some features would affect biotopes (e.g. scallops, mussels), but these would recover relatively rapidly
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(N-M1)	(M1)	(L-M1)	(M1)	(M-H1)	(M1)	1 - features associated with some of the biotopes could be removed to a significant extent and are likely to have low recovery (e.g.A4.211; A4.22); other biotopes will have greater resistance and faster recovery

1.16 Low energy circalittoral rock

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(M-H1)	(L1)	(H1)	(L1)	(NS-L1)	(L1)	1 - Some copnstituent biotopes exist in very sheltered areas and an increase in water movements and/or wave action may influence community composition, recovery would be predicted to be high.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(M-H1)	(L1)	(H1)	(L1)	(NS-L1)	(L1)	1 - Some copnstituent biotopes exist in very sheltered areas and an increase in water movements and/or wave action may influence community composition, recovery would be predicted to be high.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(N-H1)	(L1)	(M-H1)	(L1)	(L-M1)	(L1)	1. Overall it was judged likely that the resistance of constituent biotopes would vary from none to high from biotopes in deeper waters which experience stable conditions to coastal biotopes which are adapted to fluctuations. Resilience was judged to vary from high (for high resistance biotopes) to medium (within 2-10 years).
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(M-H1)	(L1)	(H1)	(L1)	(NS-L1)	(L1)	1 - Some copnstituent biotopes exist in very sheltered areas and an increase in water movements and/or wave action may influence community composition, recovery would be predicted to be high.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(M-H1)	(L1)	(H1)	(L1)	(NS-L1)	(L1)	1 - Some copnstituent biotopes exist in very sheltered areas and an increase in water movements and/or wave action may influence community composition, recovery would be predicted to be high.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(L-M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Changes in turbidity may inhibit feeding rates by the suspension feeding sessile epibenthos that characterise this habitat and clog respiration organs.
ges	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical chan	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N1)	(L1)	(M1)	(L1)	(M1)	(L1)	
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
image	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(L-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1 - In the low energy biotopes that constitute this broad-scale habitat, the small, sessile, filter feeders could be affected by the deposition of fine sediments that clog feeding and respiration organs. Species would not be expected to avoid or re-position following deposition.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N-L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - In the low energy biotopes that constitute this broad-scale habitat, the small, sessile, filter feeders could be affected by the deposition of fine sediments that clog feeding and respiration organs. Species would not be expected to avoid or re-position following deposition.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical da	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N-L1)	(L1)	(M1)	(L1)	(M1)	(L1)	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS1)	(L1)	1 - Not Ostrea edulis habitat
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1 - constituent biotopes could be subject to significant INS impacts, assessed as medium sensitivity. A4.73 unlikely to be significantly affected, assessed as not sensitive
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - few commercially exploited features present (lobster, crab?)
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(N-M1)	(L1)	(L-H1)	(L1)	(L-H1)	(L1)	1 - features associated with some of the biotopes could be removed to a significant extent with variable recovery (e.g. A4.714 has low recovery)

1.17 Subtidal coarse sediments

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					NS	(L)	6 - based on constituent biotopes; Subtidal sands and gravels (see Annex G, Section 2.39),
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L)	6 - based on constituent biotopes; Subtidal sands and gravels (see Annex G, Section 2.39),
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This feature and constituent biotopes are subtidal features and hence are judged to be not exposed to changes at the pressure benchmark which are of relevance only to intertidal features. Some effects may occur in some areas where shallow subtidal populations shift gradually in response to altered conditions.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NS	(L)	6 - based on constituent biotopes; Subtidal sands and gravels (see Annex G, Section 2.39),
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NS	(L)	6 - based on constituent biotopes; Subtidal sands and gravels (see Annex G, Section 2.39),
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(N-H1)	(L1)	(M-H1)	(L1)	(L-M1)	(L1)	It was judged likely that the resistance of constituent biotopes would vary from none for coarse sediments in deeper waters e.g. deep circalittoral coarse sediments which experience stable conditions, to high for biotopes which are adapted to fluctuations in salinity. Resilience was judged to vary from high (for high resistance biotopes) to medium (within 2-10 years).

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS6)	(L1)	6 - based on constituent biotopes; Subtidal sands and gravels (see Annex G, Section 2.39).
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This feature and constituent biotopes are subtidal features and hence are judged to be not exposed to changes at the pressure benchmark which are of relevance only to intertidal features. Some effects may occur in some areas where shallow subtidal populations shift gradually in response to altered conditions.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NS	(L)	
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS6)	(L1)	6 - based on constituent biotopes; Subtidal sands and gravels (see Annex G, Section 2.39).
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS6)	(L1)	6 - based on constituent biotopes; Subtidal sands and gravels (see Annex G, Section 2.39), Edwardsia timidia (see Annex G, Section 3.12)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M6)	(L1)	6 - based on constituent biotopes; Subtidal sands and gravels.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(NS-M6)	(L1)	6 - based on constituent biotopes; Subtidal sands and gravels (see Annex G, Section 2.39).
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(NS-M6)	(L1)	6 - based on constituent biotopes; Subtidal sands and gravels.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(L-M6)	(L1)	6 - based on constituent biotopes; Subtidal sands and gravels.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(L-M7)	(L1)	7 - Assessment made at second workshop, the constituent biotopes of this broadscale habitat feature is characterised by infauna which would have low resistance to subsurface abrasion which would move stones etc. causing disturbance and damage. However recovery is predicted to be high based on expert knowledge of habitats which are characterised by ephemeral fauna which would recover quickly.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(NS-H7)	(L1)	7 - Assessment made at second workshop, although resistance to surface damage is low as some elements of the biological assemblage occur at the surface, recovery is predicted to be rapid <2 years and hence sensitivity is low.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(L-H10)	(L1)	10 - Expert reviewer considered that all the subtidal sediments should range from L to H sensitivity on the basis that stable diverse communities will exist in some areas whilst mobile and less diverse areas will exist in others.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ssures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS1)	(L1)	1 - Not Ostrea edulis habitat

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pres	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1 - potential impact of INS in 5.13 and 5.14 which could be substantial e.g. Crepidula
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - no features targeted directly
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1 - commerical harvesting would signifiantly affect more stable biotopes but have little impact on more mobile features (e.g. A5.121)

1.18 Subtidal sand

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(M-H1)	(L1)	(NS-L1)	(L1)	1. Not sensitive or low sensitivity to this pressure benchmark- based on the assumption that the change in water flow rates do not lead to erosion or the habitats that characterise this broadscale feature- In some areas finer sediments may be winnowed and the substrate may become coarser e.g.change from muddy to sand- however this substrate would still support biotopes characteristic of this feature. As the characterising species (EUNIS classification) are relatively short-lived and common with many recruiting through planktonic larvae recovery is expected to be within 2-10 years.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This feature and constituent biotopes are subtidal features and hence are judged to be not exposed to changes at the pressure benchmark which are of relevance only to intertidal features. Some effects may occur in some areas where shallow subtidal populations shift gradually in response to altered conditions.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Hydrological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(N-H1)	(L1)	(M-H1)	(L1)	(L-M1)	(L1)	1. Constituent biotopes (see EUNIS classification) occur across a salinity gradient from locations of variable salinity e.g. estuaries, to the fully marine environment, tolerances to salinity changes will vary, overall it was judged likely that the resistance of constituent biotopes would vary from none to high from subtidal sands in deeper waters which experience stable conditions to estuarine biotopes which are adapted to fluctuations. Resilience was judged to vary from high (for high resistance biotopes) to medium (within 2 10 years). Characterising species tend to be short lived and are common species with larval supply so that recovery may tend towards the shorter end of the medium scale.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(M-H1)	(L1)	(NS-L1)	(L1)	1. Not sensitive or low sensitivity to this pressure benchmark- based on the assumption that the change in water flow rates do not lead to erosion or the habitats that characterise this broadscale feature- In some areas finer sediments may be winnowed and the substrate may become coarser e.g.change from muddy to sand- however this substrate would still support biotopes characteristic of this feature. As the characterising species (EUNIS classification) are relatively short-lived and common with many recruiting through planktonic larvae recovery is expected to be within 2-10 years.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This feature and constituent biotopes are subtidal features and hence are judged to be not exposed to changes at the pressure benchmark which are of relevance only to intertidal features. Some effects may occur in some areas where shallow subtidal populations shift gradually in response to altered conditions.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
tion and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollu	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m^2/yr	(H4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1; sewage disposal sites eg Liverpool Bay, Thames, Nab Tower; Kenny 1992, Cogan 2010 - comparison to Holme data, KES late 90s. Assessment based on mobile epifauna, burrowing infauna (bivalves, polychaetes, echinoderms, isopods, amphipods), mainly well sorted sand
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(H4)	V(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1. Assessment based on mobile epifauna, burrowing infauna (bivalves, polychaetes, echinoderms, isopods, amphipods), mainly well sorted sand
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M4)	(M4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1. Assessment based on mobile epifauna, burrowing infauna (bivalves, polychaetes, echinoderms, isopods, amphipods), mainly well sorted sand
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L4)	(M4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1; Dogger bank study. Assessment based on mobile epifauna, burrowing infauna (bivalves, polychaetes, echinoderms, isopods, amphipods), mainly well sorted sand
ge	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4) (M L7)	(M4) (L7)	(M4) (M-H7)	(M4) (L7)	(M4) (L-M7)	(M4) (L7)	4 - based on expert judgement from workshop 1. Assessment based on mobile epifauna, burrowing infauna (bivalves, polychaetes, echinoderms, isopods, amphipods), mainly well sorted sand. 7 - Assessment made at second workshop. Resistance: e.g. based on Cable laying activities would be low-medium, Recovery: M-H, there are places, for example in the Irish sea, where this is predicted to be rapid e.g. sandbanks which are mobile features with associated disturbance adapted biological assemblages.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical dama	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L-H7)	(L7)	(M-H7)	(L7)	(NS-M7)	(L7)	7. Assessment made at second workshop. Medium-High resistance for sandbank and wave disturbed sediments in dynamic environments, low for maldanid polychaetes and other sedentary, tube dwellers, Recovery: some elements e.g. sandbanks will be high, medium for more sheltered areas
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4) (M-H7)	(L4)	(H4) (M-H7)	(L4) (L7)	(L4) (NS-M7)	(L4) (L7)	4 - based on expert judgement from workshop 1. Assessment based on mobile epifauna, burrowing infauna (bivalves, polychaetes, echinoderms, isopods, amphipods), mainly well sorted sand. 7 - Assessment made at second workshop medium- high resistance expected over the range of biotopes, high recovery within 2 years.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(M4)	(M4)	(M4)	(M4) (L-H 10)	(M4)	4 - based on expert judgement from workshop 1; Boyd et al, Thames Estuary; Kenny, Boyd - Cefas studies, ALSF, ICES reports. Assessment based on mobile epifauna, burrowing infauna (bivalves, polychaetes, echinoderms, isopods, amphipods), mainly well sorted sand. 10 - Expert reviewer considered that all the subtidal sediments should range from L to H sensitivity on the basis that stable diverse communities will exist in some areas whilst mobile and less diverse areas will exist in others.
ner physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Oth	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1 - More mobile biotopes unlikely to experience significant INS impacts. More stable muddy sands at risk fro species such as Crepidula
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1) (NS6)	(L1)	1 - features not targted directly
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M-H1)	(H1)	(M-H1)	(H1)	(NS-M1)	(H1)	1 - more mobile biotopes will not be sensitive but more stable muddy sands would be affected

1.19 Subtidal mud

Pressure theme	Pressure	Benchmark	Sensitivity Assessment: Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(M-H1)	(L1)	(NS-L1)	(L1)	1. Not sensitive or low sensitivity to this pressure benchmark- based on the assumption that the change in water flow rates do not lead to erosion or the mud habitats that characterise this broadscale feature- In some areas finer sediments may be winnowed and the substrate may become coarser e.g.change to muddy sand from mud- however this substrate would still support biotopes characteristic of this feature. Mud sediments can have cohesive properties and therefore have some resistance to erosion. The sensitivity assessment reflects this and, as the characterising species (EUNIS classification) are relatively short-lived and common with many recruiting through planktonic larvae recovery is expected to be within 2-10 years.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This feature and constituent biotopes are subtidal features and hence are judged to be not exposed to changes at the pressure benchmark which are of relevance only to intertidal features. Some effects may occur in some areas where shallow subtidal populations shift gradually in response to altered conditions.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H1)	(L1)	(M-H1)	(L1)	(NS-L1)	(L1)	1. Not sensitive or low sensitivity to this pressure benchmark- based on the assumption that the change in wave action rates do not lead to erosion or the mud habitats that characterise this broadscale feature- In some areas finer sediments may be winnowed and disturbed and the substrata may become coarser e.g.change to muddy sand from mud- however this substrata would still support biotopes characteristic of this feature. Mud sediments can have cohesive properties and therefore have some resistance to erosion though increased wave action. The sensitivity assessment reflects this and, as the characterising species (EUNIS classification) are relatively short-lived and common with many recruiting through planktonic larvae recovery is expected to be within 2-10 years.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(M6)	(L1)	6 - based on constituent biotopes; Sea-pen and burrowing megafauna communities (see Annex G, Section 2.26), Burrowed mud (see Annex G, Section 2.2), Inshore deep mud with burrowing heart urchins (see Annex G, Section 2.16)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L-M6)	(L1)	6 - based on constituent biotopes; Sea-pen and burrowing megafauna communities (see Annex G, Section 2.26), Burrowed mud (see Annex G, Section 2.2), Inshore deep mud with burrowing heart urchins (see Annex G, Section 2.16)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(M-H1)	(L1)	(NS-L1)	(L1)	1. Not sensitive or low sensitivity to this pressure benchmark- based on the assumption that the change in water flow rates do not lead to erosion or the mud habitats that characterise this broadscale feature- In some areas finer sediments may be winnowed and the substrate may become coarser e.g.change to muddy sand from mud- however this substrate would still support biotopes characteristic of this feature. Mud sediments can have cohesive properties and therefore have some resistance to erosion. The sensitivity assessment reflects this and, as the characterising species (EUNIS classification) are relatively short-lived and common with many recruiting through planktonic larvae recovery is expected to be within 2-10 years.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This feature and constituent biotopes are subtidal features and hence are judged to be not exposed to changes at the pressure benchmark which are of relevance only to intertidal features. Some effects may occur in some areas where shallow subtidal populations shift gradually in response to altered conditions.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
H	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H1)	(L1)	(M-H1)	(L1)	(NS-L1)	(L1)	1. Not sensitive or low sensitivity to this pressure benchmark- based on the assumption that the change in wave action rates do not lead to erosion or the mud habitats that characterise this broadscale feature- In some areas finer sediments may be winnowed and disturbed and the substrata may become coarser e.g.change to muddy sand from mud- however this substrata would still support biotopes characteristic of this feature. Mud sediments can have cohesive properties and therefore have some resistance to erosion though increased wave action. The sensitivity assessment reflects this and, as the characterising species (EUNIS classification) are relatively short-lived and common with many recruiting through planktonic larvae recovery is expected to be within 2-10 years.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS6)	(L)	6 - based on constituent biotopes; Sea-pen and burrowing megafauna communities (see Annex G, Section 2.26), Burrowed mud (see Annex G, Section 2.2), Inshore deep mud with burrowing heart urchins (see Annex G, Section 2.16)
other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and o	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS-H6)	(L1)	6 - based on constituent biotopes; Sea-pen and burrowing megafauna communities (see Annex G, Section 2.26), Burrowed mud (see Annex G, Section 2.2), Inshore deep mud with burrowing heart urchins (see Annex G, Section 2.16)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M6)	(L1)	6 - based on constituent biotopes; Sea-pen and burrowing megafauna communities (see Annex G, Section 2.26), Burrowed mud (see Annex G, Section 2.2), Inshore deep mud with burrowing heart urchins (see Annex G, Section 2.16)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(NS-L6)	(L1)	6 - based on constituent biotopes; Sea-pen and burrowing megafauna communities (see Annex G, Section 2.26), Burrowed mud (see Annex G, Section 2.2), Inshore deep mud with burrowing heart urchins (see Annex G, Section 2.16)
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(M6)	(L1)	6 - based on constituent biotopes; Sea-pen and burrowing megafauna communities (see Annex G, Section 2.26), Burrowed mud (see Annex G, Section 2.2), Inshore deep mud with burrowing heart urchins (see Annex G, Section 2.16)
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(M6)	(L1)	6 - based on constituent biotopes; Sea-pen and burrowing megafauna communities (see Annex G, Section 2.26), Burrowed mud (see Annex G, Section 2.2), Inshore deep mud with burrowing heart urchins (see Annex G, Section 2.16)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(M6)	(L1)	6 - based on constituent biotopes; Sea-pen and burrowing megafauna communities (see Annex G, Section 2.26), Burrowed mud (see Annex G, Section 2.2), Inshore deep mud with burrowing heart urchins (see Annex G, Section 2.16)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(L-M6)	(L1)	6 - based on constituent biotopes; Sea-pen and burrowing megafauna communities (see Annex G, Section 2.26), Burrowed mud (see Annex G, Section 2.2), Inshore deep mud with burrowing heart urchins (see Annex G, Section 2.16)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(M6)	(L1)	6 - based on constituent biotopes; Sea-pen and burrowing megafauna communities (see Annex G, Section 2.26), Burrowed mud (see Annex G, Section 2.2), Inshore deep mud with burrowing heart urchins (see Annex G, Section 2.16)
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS6)	(L1)	6 - based on constituent biotopes; Sea-pen and burrowing megafauna communities (see Annex G, Section 2.26), Burrowed mud (see Annex G, Section 2.2), Inshore deep mud with burrowing heart urchins (see Annex G, Section 2.16)
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1 - Some biotopes at risk from INS such as Crepidula but not A5.37
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L-H1)	(L-H1)	(M-H1)	(M-H1)	(NS-M1)	(L-H1)	1 - some biotopes (e.g. A5.341) may be targeted directly, but generally few others
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L-M1)	(L-H1)	(M-H1)	(M-H1)	(M1) (M6)	(L-H1)	6 - based on constituent biotopes; Sea-pen and burrowing megafauna communities (see Annex G, Section 2.26), Burrowed mud (see Annex G, Section 2.2), Inshore deep mud with burrowing heart urchins (see Annex G, Section 2.16)

1.20 Subtidal mixed sediments

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS-L6)	(L1)	6 - based on constituent biotopes; Subtidal mixed muddy sediments (see Annex G, Section 2.38-not sensitive), Ostrea edulis beds (see Annex G, Section 2.27-not sensitive), file/flame shell beds (see Annex G, Section 2.11-low sensitivity)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This feature and constituent biotopes are subtidal features and hence are judged to be not exposed to changes at the pressure benchmark which are of relevance only to intertidal features. Some effects may occur in some areas where shallow subtidal populations shift gradually in response to altered conditions.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS-L6)	(L1)	6 - based on constituent biotopes; Subtidal mixed muddy sediments (see Annex G, Section 2.38), Ostrea edulis beds (see Annex G, Section 2.27)
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(M6)	(L1)	6 - based on constituent biotopes; Subtidal mixed muddy sediments (see Annex G, Section 2.38), Ostrea edulis beds (see Annex G, Section 2.27)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS-H6)	(L1)	6 - based on constituent biotopes; Subtidal mixed muddy sediments (see Annex G, Section 2.38), Ostrea edulis beds (see Annex G, Section 2.27)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS-L6)	(L1)	6 - based on constituent biotopes; Subtidal mixed muddy sediments (see Annex G, Section 2.38-not sensitive), Ostrea edulis beds (see Annex G, Section 2.27-not sensitive), file/flame shell beds (see Annex G, Section 2.11-low sensitivity)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This feature and constituent biotopes are subtidal features and hence are judged to be not exposed to changes at the pressure benchmark which are of relevance only to intertidal features. Some effects may occur in some areas where shallow subtidal populations shift gradually in response to altered conditions.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS-L6)	(L1)	6 - based on constituent biotopes; Subtidal mixed muddy sediments (see Annex G, Section 2.38), Ostrea edulis beds (see Annex G, Section 2.27)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS-M6)	(L1)	6 - based on constituent biotopes; Subtidal mixed muddy sediments (see Annex G, Section 2.38-not sensitive), Ostrea edulis beds (see Annex G, Section 2.27-medium); file/flame shell beds (see Annex G, Section 2.11-not sensitive.
other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and o	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS6)	(L1)	6 - based on constituent biotopes; Subtidal mixed muddy sediments (see Annex G, Section 2.38), Ostrea edulis beds (see Annex G, Section 2.27), file/flame shell beds (see Annex G, Section 2.11) - all not sensitive.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H6)	(L1)	6 - based on constituent biotopes; Subtidal mixed muddy sediments (see Annex G, Section 2.38), Ostrea edulis beds (see Annex G, Section 2.27)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - The feature comprises mixed sediments including mud and it is judged to therefore host a biological assemblage which contains species adapted to mud conditions and that experience re-suspension of sediments by natural processes, this feature is therefore judged to have a high resistance and high recovery to low siltation events although some physiological effects on species may occur..
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - While this feature is judged to be not sensitive to low siltation events that addition of 30cm of sediment would constitute a large change in habitat conditions which would be predicted to lead to substantial mortality of epifaunal and infaunal species. The resistance to such an event was judged to be low and recovery following sediment removal to take between 2-10 years.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(H6)	(L1)	6 - based on constituent biotopes; Subtidal mixed muddy sediments (see Annex G, Section 2.38-high sensitivity), Ostrea edulis beds (see Annex G, Section 2.27high sensitivity), file/flame shell beds (see Annex G, Section 2.11-high sensitivity) all not sensitive.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(H1)	(L1)	1 -The assessment was based on Hall et al. 2008,(habitat groups, stable muddy sands, sandy muds and muds, stable spp. rich mixed sediments)where this feature was judged to be highly sensitive to heavy abrasion.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(M6)	(L1)	6 - based on constituent biotopes; Subtidal mixed muddy sediments (see Annex G, Section 2.38-medium sensitivity), Ostrea edulis beds (see Annex G, Section 2.27-medium sensitivity), File and flame shells- (see Annex G, Section 2.11-medium sensitivity). Fishing effects on epifauna and infauna, tubiculous polychaetes, sessile fragile bivalves
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(H6)	(L1)	6 - based on constituent biotopes; Subtidal mixed muddy sediments (see Annex G, Section 2.38), Ostrea edulis beds (see Annex G, Section 2.27), file/flame shell beds (see Annex G, Section 2.11).
...er physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Oth	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS-H1)	(L1)	1 - High sensitivity based on Ostrea edulis beds, other constituent biotopes not sensitive.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-H1)	(L1)	(M1)	(M1)	(L-M1)	(M1)	1 - coarser substrates may be susceptible to INS but muddier habitats may be resistant
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(M-H1)	(M1)	(H1)	(M1)	(L1)	(M1)	1 - Target species could include scallop, but recovery likely to be high; evidence fro assessment of scallop fisheries
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L-M1)	(M1)	(M1)	(M1)	(M1)	(M1)	1 - commercial harvesting methods may remove non-target species in significant quantities. Evidence from e.g. scallop dredging

1.21 Subtidal macrophyte-dominated sediment

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31). The sensitivity of these constituent biotopes ranges from NE (subtidal constituents) to M- where intertidal. As this broadscale habitat is specifically subtidal, the feature assessment is NE not exposed.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M6)	(L1)	6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31)
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS-M6)	(L1)	6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19-not sensitive), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20-not sensitivie), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17-not sensitive), Seagrass beds (see Annex G, Section 2.31-medium sensitivity)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1. This feature and constituent biotopes are subtidal features and hence are judged to be not exposed to changes at the pressure benchmark which are of relevance only to intertidal features. Some effects may occur in some areas where shallow subtidal populations shift gradually in response to altered conditions.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS-M6)	(L1)	6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19-not sensitive), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20-not sensitive), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17-not sensitive), Seagrass beds (see Annex G, Section 2.31-medium sensitivity)
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L4)	(M4)	(H4)	(M4)	(L4) (NS-H6)	(M4)	4 - based on expert judgement from workshop 1; based on assessment of kelp and seaweed on sublittoral sediment 6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(H4)	(L4)	(H4)	(L4)	(NS4) (NS-H6)	(L4)	4 - based on expert judgement from workshop 1; based on assessment of kelp and seaweed on sublittoral sediment 6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19 -high sensitivity), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20 - high sensitivity), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17 -not sensitive), Seagrass beds (see Annex G, Section 2.31 -not sensitive)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS-M6)	(L1)	6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19-not sensitive), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20-not sensitivie), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17-not sensitive), Seagrass beds (see Annex G, Section 2.31-medium sensitivity)
Hydrological changes (inshore/local)	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(NE4)	(L1)	4 - based on expert judgement from workshop 1. Feature is specifically subtidal and not exposed to changes in emergence regime.
Hydrological changes (inshore/local)	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS-M6)	(L1)	6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19-not sensitive), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20-not sensitive), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17-not sensitive), Seagrass beds (see Annex G, Section 2.31-medium sensitivity)
Hydrological changes (inshore/local)	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(L4) (L-H6)	(L1)	4 - based on expert judgement from workshop 1; based on assessment of kelp and seaweed on sublittoral sediment 6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19-high sensitivity), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20-high sensitivity), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17-low sensitivity), Seagrass beds (see Annex G, Section 2.31- low to high sensitivity)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS-M6)	(L1)	6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M-H6)	(L1)	6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	Feature would be highly sensitive to permanent loss of habitat to land or freshwater

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(NS-H6)	(L1)	6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31)
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(M-H6)	(L1)	6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31)
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(M-H6)	(L1)	4 - based on expert judgement from workshop 1; based on assessment of kelp and seaweed on sublittoral sediment 6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(L4) (L-H6)	(L1)	4 - based on expert judgement from workshop 1; based on assessment of kelp and seaweed on sublittoral sediment 6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(L4) (L H6)	(L1)	4 - based on expert judgement from workshop 1; based on assessment of kelp and seaweed on sublittoral sediment 6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(M4) (M-H6)	(L1)	4 - based on expert judgement from workshop 1; based on assessment of kelp and seaweed on sublittoral sediment 6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31)
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-M1)	(L-H1)	(L-M1)	(M1)	(M-H6)	(L1)	6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31)
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(N-H1)	(L-H1)	(L-H1)	(L1)	(NS-H 1&6)	(L1)	1 - some biotopes (maerl, kelp) may be targeted directly; others will not be targeted directly 6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31)
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(N-M1)	(L1)	(L-M1)	(L1)	(M-H1) (NS-H6)	(L1)	1 - scope for significant non-target removal with often low recovery 6 - based on constituent biotopes; Maerl beds (see Annex G, Section 2.19), Maerl or coarse shell gravel with burrowing sea cucumbers (see Annex G, Section 2.20), Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17), Seagrass beds (see Annex G, Section 2.31)

1.22 Subtidal biogenic reefs

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS-M6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This feature and constituent biotopes are subtidal features and hence are judged to be not exposed to changes at the pressure benchmark which are of relevance only to intertidal features. Some effects may occur in some areas where shallow subtidal populations shift gradually in response to altered conditions.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS-H6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(NS-H6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS-L6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS-M6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This feature and constituent biotopes are subtidal features and hence are judged to be not exposed to changes at the pressure benchmark which are of relevance only to intertidal features. Some effects may occur in some areas where shallow subtidal populations shift gradually in response to altered conditions.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS-H6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS-L6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
es	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical change	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M-H6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(NS-M6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(L-H6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(M-H6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(M-H6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(L-M6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(M-H6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS6)	(L1)	6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-H1)	(L1)	(M-H1)	(L1)	(NS-M1) (NS-H6)	(L1)	1 - Sabellaaria reefs likely to be NS; serpulid reefs likely to be sensitive to some INS 6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(N-H1)	(M-H1)	(L-H1)	(M1)	(NS-H 1&6)	(M1)	1 - some biotopes targeted directly (mussels); others not targeted (Sabellaria, vents) 6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(N-H1)	(L1)	(L-H1)	(L1)	(NS-H 1&6)	(L1)	1 - some biotopescould be significantly damaged (e.g. Sabellaria, mussels) but others relatively unaffected (e.g. freshwater, oil seeps) 6 - based on constituent biotopes; Sabellaria spinulosa (see Annex G, Section 2.30), Sabellaria alveolata (see Annex G, Section 2.29), Horse mussel beds (see Annex G, Section 2.21), Blue mussel beds (see Annex G, Section 2.1)

1.23 Deep-sea bed

Pressure theme	Pressure	Benchmark	Sensitivity Assessment: Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - The deep sea bed is a EUNIS level 2 description and incorporates all the deep sea broadscale habitats in the matrix the assessments below are all based on the range of assessed sensitivites for these (see Annex G 1.23-1.29).
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H1)	(L1)	1 - The deep sea bed is a EUNIS level 2 description and incorporates all the deep sea broadscale habitats in the matrix the assessments below are all based on the range of assessed sensitivites for these (see Annex G 1.23-1.29).
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical c	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS-H1)	(L1)	1 - The deep sea bed is a EUNIS level 2 description and incorporates all the deep sea broadscale habitats in the matrix the assessments below are all based on the range of assessed sensitivites for these (see Annex G 1.23-1.29). All are assessed as high sensitivity with the exception of raised features of the deep sea bed which ranges from NS-H. The NS sensitivity is based on coral carbonate mounds.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H1)	(L1)	1 - The deep sea bed is a EUNIS level 2 description and incorporates all the deep sea broadscale habitats in the matrix the assessments below are all based on the range of assessed sensitivites for these (see Annex G 1.23-1.29).
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
image	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(L-H8)	(L1)	1 - The assessment is based on expert judgement from Plymouth workshop for Deep Sea trenches, canyons etc. (see Annex G1.31). The sensitivity range recognsies that deep sea broadscale habitats are composed of habitats with varying sensitivty. The high sensitivity reflects that sedimentation rates in some stable habitats are very low and therefore biological assemblages in these habitats are highly sensitive to change in physical conditions. The confidence rating of low for this assessment reflects the
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(L-H8)	(L1)	
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(H1)	(L1)	

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical da	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(H1)	(L1)	confidence rating of low for this assessment reflects the uncertainty of extrapolating expert judgement to similar habitats.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(H1)	(L1)	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(H1)	(L1)	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					(NS-M1)	(L1)	1 - The deep sea bed is a EUNIS level 2 description and incorporates all the deep sea broadscale habitats in the matrix the assessments below are all based on the range of assessed sensitivites for these (see Annex G 1.23-1.29).
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(NS-H1)	(L1)	
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(NS-H1)	(L1)	

1.24 Deep-sea rock and other artificial hard substrata

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. The definition of this feature refers to geomorphological components only and therefore no assessments of biological assemblage have been undertaken as part of this assessment
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other c	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS-H1)	(L1)	1 - The deep sea bed is a EUNIS level 2 description and incorporates all the deep sea broadscale habitats in the matrix the assessments below are all based on the range of assessed sensitivites for these (see Annex G 1.23-1.29). All are assessed as high sensitivity with the exception of raised features of the deep sea bed which ranges from NS-H. The NS sensitivity is based on coral carbonate mounds.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H1)	(L1)	1 - Communities found on rock and artifical hard substrata are likely to be highly sensitive to a change in seabed type and to recover slowly.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(L-H1)	(L1)	
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(L-H1)	(L1)	
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

1.25 Deep-sea mixed substrata

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(NS1)	(L1)	1 - Not Sensitive to this pressure benchmark, the definition of this feature refers to geomorphological components and macrophyte debris only and therefore no assessments of biological assemblage have been undertaken as part of this assessment
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(L-H1)	(L1)	
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(L-H1)	(L1)	
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(NS1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)

1.26 Deep-sea sand

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
nshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ir	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(L-H1)	(L1)	
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(L-H1)	(L1)	
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(NS1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)

1.27 Deep-sea muddy sand

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
nshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ir	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(L-H1)	(L1)	
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(L-H1)	(L1)	
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
Physical damage	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
Physical damage	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(NS1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(H1)	(L1)	1 - Based on coral gardens (see Annex G, Section 2.7)

1.28 Deep-sea mud

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H1)	(L1)	
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
nshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ir	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(N6)	(H6)	(L6)	(M6)	(H6)	(M6)	6 - based on constituent biotopes; Mud habitats in deep water (see Annex G, Section 2.22)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H6)	(L1)	6 - based on constituent biotopes; Mud habitats in deep water (see Annex G, Section 2.22)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(N6)	(L6)	(L6)	(L6)	(H6)	(L6)	6 - based on constituent biotopes; Mud habitats in deep water (see Annex G, Section 2.22)
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N6)	(L6)	(VL6)	(L6)	(H6)	(L6)	6 - based on constituent biotopes; Mud habitats in deep water (see Annex G, Section 2.22)
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N6)	(M6)	(L4)	(M6)	(H6)	(M6)	6 - based on constituent biotopes, including Coral Gardens (see Annex G, Section 2.7), Mud habitats in deep water (see Annex G, Section 2.22)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N6)	(M6)	(L6)	(M6)	(H6)	(M6)	6 - based on constituent biotopes, including Coral Gardens (see Annex G, Section 2.7), Mud habitats in deep water (see Annex G, Section 2.22)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(N-H6)	(M-H6)	(VL-H6)	(M-H6)	(NS-H6)	(M-H6)	6 - based on constituent biotopes, including Coral Gardens (see Annex G, Section 2.7 -high sensitivity), Mud habitats in deep water (see Annex G, Section 2.22 -not sensitive)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N6)	(M6)	(L6)	(M6)	(H6)	(M6)	6 - based on constituent biotopes; Mud habitats in deep water (see Annex G, Section 2.22)
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H6)	(L6)	(M6)	(L6)	(L6)	(L6)	6 - based on constituent biotopes; Mud habitats in deep water (see Annex G, Section 2.22)
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L6)	(H6)	(L6)	(H6)	(H6)	(H6)	6 - based on constituent biotopes; Mud habitats in deep water (see Annex G, Section 2.22)

1.29 Deep-sea bioherms

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H1)	(L1)	1 - feature would be highly sensitive to regional/national tidal and ocean current changes
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
nshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ir	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS1 (NS8)	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment. 8 - based on expert judgement from workshop 3
	Organic enrichment	100gC/m²/yr					(H8)	(L1)	8 - based on expert judgement from workshop 3
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N6)	(H6)	(VL6)	(H6)	(H6) (H8)	(H6)	6 - based on constituent biotopes; Deep sea sponge aggregations (see Annex G, Section 2.8) 8 - based on expert judgement from workshop 3- cold water corals (see Annex G
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(N6)	(L6)	(VL6)	(H6)	(H6) (H8)	(L6)	6 - based on constituent biotopes; Deep sea sponge aggregations (see Annex G, Section 2.8) 8 - based on expert judgement from workshop 3
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N6)	(L6)	(VL6)	(H6)	(H6) (H8)	(L6)	6 - based on constituent biotopes; Deep sea sponge aggregations (see Annex G, Section 2.8) 8 - based on expert judgement from workshop 3
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N6)	(H6)	(VL6)	(H6)	(H6) (H7)	(H6)	6 - based on constituent biotopes; Deep sea sponge aggregations (see Annex G, Section 2.8) 7 - based on expert judgement from workshop 2
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N6)	(H6)	(VL6)	(H6)	(H6) (H7)	(H6)	6 - based on constituent biotopes; Deep sea sponge aggregations (see Annex G, Section 2.8) 7 - based on expert judgement from workshop 2
Physical damage	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(N6)	(H6)	(VL6)	(H6)	(H6) (H7)	(H6)	6 - based on constituent biotopes; Deep sea sponge aggregations (see Annex G, Section 2.8) 7 - based on expert judgement from workshop 2
Physical damage	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N6)	(H6)	(VL6)	(H6)	(H6) (H7)	(H6)	6 - based on constituent biotopes; Deep sea sponge aggregations (see Annex G, Section 2.8) 7 - based on expert judgement from workshop 2

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
...essures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pre	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(N6)	(H6)	(VL6)	(H6)	(H6)	(H6)	6 - based on constituent biotopes; Deep sea sponge aggregations (see Annex G, Section 2.8)

1.30 Raised features of the deep-sea bed

Pressure theme	Pressure	Benchmark	Sensitivity Assessment: Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	The assessments for this feature are based on seamounts (Annex G 2.32) and coral carbonate mounds (see Annex G 2.6) as these are two major habitat types found within this broadscale habitat (see EUNIS classification). (There was no information on other components abyssal hills and oceanic ridges).
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M6)	(L1)	6 - Assessment based on seamounts (Annex G 2.32) and coral carbonate mounds (see Annex G 2.6). The low confidence reflects either the low confidence of these assessments and/or the uncertainty inherent in using assessments of constituent biotopes to assess broadscale habitats.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H6)	(L1)	6 - Assessment based on seamounts (Annex G 2.32) and coral carbonate mounds (see Annex G 2.6). The low confidence reflects either the low confidence of these assessments and/or the uncertainty inherent in using assessments of constituent biotopes to assess broadscale habitats.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NE	(L1)	1 - Not exposed to this pressure benchmark

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NE	(L1)	
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS6)	(L1)	6 - Assessment based on seamounts (Annex G 2.32) and coral carbonate mounds (see Annex G 2.6). The low confidence reflects either the low confidence of these assessments and/or the uncertainty inherent in using assessments of constituent biotopes to assess broadscale habitats.
ther chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and ot	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS-H6)	(L1)	6 - Assessment based on seamounts -H-(Annex G 2.32) and coral carbonate mounds-NS- (see Annex G 2.6). The low confidence reflects either the low confidence of these assessments and/or the uncertainty inherent in using assessments of constituent biotopes to assess broadscale habitats.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H6)	(L1)	6 - Assessment based on seamounts -H-(Annex G 2.32) and coral carbonate mounds-H- (see Annex G 2.6). The low confidence reflects either the low confidence of these assessments and/or the uncertainty inherent in using assessments of constituent biotopes to assess broadscale habitats.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(H6)	(L1)	6 - Assessment based on seamounts -H-(Annex G 2.32) and coral carbonate mounds-NS- (see Annex G 2.6). The low confidence reflects either the low confidence of these assessments and/or the uncertainty inherent in using assessments of constituent biotopes to assess broadscale habitats.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(H6)	(L1)	
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(H6)	(L1)	
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(H6)	(L1)	

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(H6)	(L1)	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(H6)	(L1)	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(NS1)	(L1)	1. Feature judged to be not sensitive as it is not a target species commercially expoited.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(H6)	(L1)	6 - Assessment based on seamounts -H-(Annex G 2.32) and coral carbonate mounds-H- (see Annex G 2.6). The low confidence reflects either the low confidence of these assessments and/or the uncertainty inherent in using assessments of constituent biotopes to assess broadscale habitats.

1.31 Deep-sea trenches and canyons, channels, slope failures and slumps on the continental slope

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H1)	(L1)	
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(N8)	(H8)	(VL8)	(H8)	NE (H8)	(H8)	Not exposed to this pressure benchmark 8 - based on expert judgement from Plymouth workshop
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(N8)	(H8)	(VL8)	(H8)	NE (H8)	(H8)	Not exposed to this pressure benchmark 8 - based on expert judgement from Plymouth workshop
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year		(VL3)		(H3)	(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.4)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (insh	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(NE1) (NE8)	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS8)	(L1)	8 - based on expert judgement from Plymouth workshop
tion and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls	(L8)	(L8)	(VL8)	(L8)	NS (H8)	(L8)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment. 8 - based on expert judgement from Plymouth workshop
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls	(L8)	(L8)	(VL8)	(L8)	NS (H8)	(L8)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment. 8 - based on expert judgement from Plymouth workshop
	Radionuclide contamination	10 µGy/h	(L8)	(L8)	(VL8)	(L8)	NS (H8)	(L8)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment. 8 - based on expert judgement from Plymouth workshop
	Introduction of other substances (solid, liquid or gas)	Not assessed	(L8)	(L8)	(VL8)	(L8)	NA (H8)	(L8)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment. 8 - based on expert judgement from Plymouth workshop

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollu	De-oxygenation	Compliance with WFD criteria for good status	(L8)	(L8)	(VL8)	(L8)	NS (H8)	(L8)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment. 8 - based on expert judgement from Plymouth workshop
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status	(H8)	(L8)	(H8)	(L8)	NS (NS8)	(L8)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment. 8 - based on expert judgement from Plymouth workshop
	Organic enrichment	100gC/m²/yr	(L8)	(M8)	(L8)	(M8)	(H8)	(M8)	8 - based on expert judgement from Plymouth workshop
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N8)				(H8)	(L1)	8 - based on expert judgement from Plymouth workshop
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(L-H8)	(L1)	8 - based on expert judgement from Plymouth workshop
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(L-H8)	(L1)	8 - based on expert judgement from Plymouth workshop
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L8)	(H8)	(L8)	(M8)	(H1) (H8)	(M8)	8 - based on expert judgement from Plymouth workshop includes coral gardens G2.7 (1)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L8)	(H8)	(L8)	(M8)	(H1) (H8)	(H8)	8 - based on expert judgement from Plymouth workshop includes coral gardens G2.7 (1)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L8)	(H8)	(L8)	(M8)	(H1) (H8)	(H8)	8 - based on expert judgement from Plymouth workshop includes coral gardens G2.7 (1)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(H1)	(L1)	1 Based on assessments for penetration, heavy abrasion and light abrasion by expert workshop 3. it was judged consistent to assess this pressure as high.
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological p	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(M8)	(H8)	(L-H8)	(H8)	(L-M8)	(H8)	8 - based on expert judgement from Plymouth workshop
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M8)	(H8)	(L-H8)	(H8)	(L-M8)	(H8)	8 - based on expert judgement from Plymouth workshop

1.32 Vents, seeps, hypoxic and anoxic habitats of the deep sea

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					NA	(L1)	This broadsclae habitat type is characterised by a range of features in the EUNIS classiffication including cetacean carcassess, gas hydrates in the deepsea, active and inactive vent fields and cold see benthic communities. Given this range and the time constraints and lack of expertise from the contractors we have not assessed the majority of pressure x feature combinations, except for blockfilling.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other c	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
essures	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pre	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

2.1 Blue mussel beds

Pressure theme	Pressure	Benchmark	Sensitivity Assessment: Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1. Mytilis beds are found in areas of high flow rates and were therefore judged by expert reviewers to be to be not sensitive to this pressure benchmark. As the assessment was based on expert judgement a low confidence level was assigned to the assessment.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(L5)	(L1)	5 - Based on expert judgement by external review.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M5)	(L1)	5 - Based on expert judgement by external review.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(L3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 2.1)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L3) (NS5)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 2.1) Mussel beds are found in areas of low salinity and expert review suggested that the feature may be not sensitive, to resolve this inconsistency a precautionary approach was adopted and the low sensitivity assessment was retained.The uncertainty surrounding this assessment is reflected in the low confidence score.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1. Mytilis beds are found in areas of high flow rates and were therefore judged by expert reviewers to be to be not sensitive to this pressure benchmark. As the assessment was based on expert judgement a low confidence level was assigned to the assessment.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(M3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 2.1)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(M3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 2.1)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(L3) (NS5)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 2.1); mussel beds are found in areas of high turbidity, and expert review suggested that the feature may be not sensitive, to resolve this a precautionary approach was adopted and the low sensitivity assessment was retained as the benchmark was felt to represent a step change in the ecosystem.The uncertainty surrounding this assessment is reflected in the low confidence score.
...anges	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical ch	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: blue mussel
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(L4)	(M4)	(M4)	(H4)	(M4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: blue mussel
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: blue mussel.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(H4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1; Little evidence available for the recoverability of a reef as it is an incredibly stochastic process with unknown variables controlling reef building. Elements used in assessment: blue mussel
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N2)	(L)	(M2)	(L)	(M2)	(L)	2 - See assessment for surface abrasion.
age	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N2)	(L)	(M2)	(L)	(M2)	(L)	2 - See assessment for surface abrasion.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical dam	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(N2)	(L)	(M2)	(L)	(M2)	(L)	2 - The key characterising species of this habitat, *Mytilis edulis,* is an attached epifaunal species that would not be able to avoid surface abrasion. Evidence indicates that similar species have undergone significant declines from trampling (loss of 54% Brosnan and Crumrine 1994 *M. californianus)* . In areas of the North Sea Mytilis edulis have replaced Sabellaria spinulosa beds that have been damaged by fishing suggesting that they have some resistance to surface abrading activities (Reise and Schubert, 1987), however greater than 75% of a mussel bed was judged to be removed by surface abrasion and hence the feature was judged to have no resistance.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N2)	(L)	(M2)	(L)	(M2)	(L)	2 - rresistance was judged to ne none- see light abrasion pressure-recoverability may take longer in some areas- however this is a common species with larval supply
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M4)	(L4)	(M4)	(L4)	(M4) (M5)	(L4)	4 - based on expert judgement from workshop 1; not verified by group but prolific nature of species suggests ability to adapt to competition. Elements used in assessment: blue mussel 5 - Supported in review by external experts.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(M4)	(H4)	(M4)	(H4)	(M4) (M5)	(H4)	4 - based on expert judgement from workshop 1 . Elements used in assessment: blue mussel 5 - supported in review by external experts
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M4)	(H4)	(M4)	(H4)	(M4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: blue mussel

2.2 Burrowed mud

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(M3)	(L3)	(M3)	(L3)	(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.2)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(VL3)	(L3)	(M3)	(L3)	(L3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.2)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (insh	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3)		(H3)		(NS3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 2.2)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M2)	(L2)	2 - based on assessment by MarLIN and ABPmer
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H3) (H7)	(M7)	(H3) (H7)	(M7)	(NS3) (NS7)	(M7)	3 - Refer to Marlin evidence (see Annex H, Section 2.2) 7 - based on expert judgement from workshop 2. Dredge material disposal, Resistance, not high amounts of mortality, possibly some community level effects. Resilience high, little to recover from in impacts. Evidence annecdotal from MALSF, Mark Russell coarser sediment work of MALSF sediments, finer sediment type, more mobile so that species are more resistant.
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N7)	(M7)	(M7)	(M7)	(M7)	(M7)	7 - based on expert judgement from workshop 2; nephrops norvegicus, seapens and subtidal mud, sediment high levels of disposal, recovery in the same time frame, published levels of confidence
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(M2) (M7)	(L1)	2 - based on assessment by MarLIN and ABPmer 7 - based on expert judgement from workshop 2
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(M7)	(M7)	(M7)	(M7)	(M2) (M7)	(M7)	2 - based on assessment by MarLIN and ABPmer 7 - based on expert judgement from workshop 2; medium sensitivity based on life history, resistance of seapens lower than nephrops, (Hall et al. 1991), pressure benchmarks, nephrops still abundant, medium confidence scientific information available, relatively good information on species life histories to support recovery assessment.
Physical damage	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M7)	(M7)	(M7)	(M7)	(M7)	(M7)	7 - based on expert judgement from workshop 2. Elements used in assessment include Nephrops norvegicus, seapens and subtidal mud, nephrops recover rapidly

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N7)	(H7)	(M7)	(H7)	(M2) (M7)	(H7)	2 - based on assessment by MarLIN and ABPmer 7 - based on expert judgement from workshop 2; most species extracted down to 30cm, recovery depending on recruits. Elements used in assessment include Nephrops norvegicus, seapens and subtidal mud, nephrops recover rapidly
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1) (L7)	(L1) (L7)	(H1) (M7)	(L1) (L7)	(NS1) (M7)	(L1) (L7)	1 - Not Sensitive to this pressure benchmark; No records of significant INS impacts in this habitat 7 - based on expert judgement from workshop 2; Crepidula can inhabit mud sediments and alter communities, for burrowed mud, there are likely to be pathways e.g. ballast water, construction activities, colonisation space, slipper limpets change the nature of the seabed, video evidence shows Crepidula and seapens don't overlap, low confidence as invasibility species specific. Recovery assumes you get rid of pressure, may not happen with invasive species.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L-M1) (M7)	(H1) (H7)	(H1) (M7)	(H1) (H7)	(L1) (M7)	(H1) (H7)	1 - Lot of evidence from Nephrops fisheries 7 - based on expert judgement from workshop 2; Target species with nephrops, part of this habitat, removal rate - scientific evidence more burrows, less than 25% , time of years females buried, deeper.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L-M1)	(H1)	M1	(H1)	(M1)	(H1)	1 - Lot of evidence from Nephrops fisheries e.g. Hinz et al 2009

2.3 Carbonate reefs

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	The Holden's Reef complex is the only known shallow water carbonate mound in Wales (and, to date, for the UK as a whole). It is situated in the northern sector of Cardigan Bay, 3 nm NW of Barmouth. Consequently, the habitat is restricted to an isolated location (MB102 C Report 16).
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark; The feature is a geomorphological phenomenon, the formative processes of which are expected to be insensitive to temperature changes, the biological assesmblage is variable and is not critical in characterising this feature.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark; The feature is a geomorphological phenomenon, the formative processes of which are expected to be insensitive to salinity changes, the biological assesmblage is variable and is not critical in characterising this feature.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark; The inshore Holden Reef complex is reported to be in an area with moderately strong tidal streams and exposed to waves, the feature is therefore judged to be tolerant of the benchmark changes in water flow and wave exposure, it should also be noted that the feature is a geomorphological phenomenon, the formative processes of are expected to be insensitive to hydrodynamic changes.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	The Holden's Reef complex is the only known shallow water carbonate mound in Wales (and, to date, for the UK as a whole). It is situated in the northern sector of Cardigan Bay, 3 nm NW of Barmouth. Consequently, the habitat is restricted to an isolated location (MB102 C Report 16).
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NS	(L1)	1 - Not Sensitive to this pressure benchmark; The inshore Holden Reef complex is reported to be in an area with moderately strong tidal streams and exposed to waves, the feature is therefore judged to be tolerant of the benchmark changes in water flow and wave exposure, it should also be noted that the feature is a geomorphological phenomenon, the formative processes of are expected to be insensitive to hydrodynamic changes.
s (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NS	(L1)	1 - Not Sensitive to this pressure benchmark; The feature is a geomorphological phenomenon, the formative processes of which are expected to be insensitive to temperature changes, the biological assesmblage is variable and is not critical in characterising this feature.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NS	(L1)	1 - Not Sensitive to this pressure benchmark; The feature is a geomorphological phenomenon, the formative processes of which are expected to be insensitive to salinity changes, the biological assesmblage is variable and is not critical in characterising this feature.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark; The inshore Holden Reef complex is reported to be in an area with moderately strong tidal streams and exposed to waves, the feature is therefore judged to be tolerant of the benchmark changes in water flow and wave exposure, it should also be noted that the feature is a geomorphological phenomenon, the formative processes of are expected to be insensitive to hydrodynamic changes.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	The Holden's Reef complex is the only known shallow water carbonate mound in Wales (and, to date, for the UK as a whole). It is situated in the northern sector of Cardigan Bay, 3 nm NW of Barmouth. Consequently, the habitat is restricted to an isolated location (MB102 C Report 16).
Hydrological changes	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NS	(L1)	1 - Not Sensitive to this pressure benchmark; The inshore Holden Reef complex is reported to be in an area with moderately strong tidal streams and exposed to waves, the feature is therefore judged to be tolerant of the benchmark changes in water flow and wave exposure, it should also be noted that the feature is a geomorphological phenomenon, the formative processes of are expected to be insensitive to hydrodynamic changes.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NS	(L1)	1 - Not Sensitive to this pressure benchmark; The feature is a geomorphological phenomenon, the formative processes of which are expected to be insensitive to water clarity changes, the biological assesmblage is variable and is not critical in characterising this feature.
emical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	The Holden's Reef complex is the only known shallow water carbonate mound in Wales (and, to date, for the UK as a whole). It is situated in the northern sector of Cardigan Bay, 3 nm NW of Barmouth. Consequently, the habitat is restricted to an isolated location (MB102 C Report 16).
Pollution and other ch	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					No Evid.	(L1)	1. No evidence was available to support assessment.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
ical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Not Sensitive to this pressure benchmark; The Holden's Reef complex in the northern part of Cardigan Bay is reported to be silty and characterised by silt-tolerant species, it was therefore judged that features of this type would be 'not sensitive' to low siltation rates (MB102 c-Report 16), however it should be noted that little information on these structures is available and this judgement is made on a single location (the only inshore carbonate reefs known).
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					No Evid.	(L1)	1 - The inshore Holden Reef complex is reported to be in an area with moderately strong tidal streams and exposed to waves. Deposits of fine materials may therefore be removed rapidly. However it was judged that there was insufficient information to make an assessment of this pressure.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	The Holden's Reef complex is the only known shallow water carbonate mound in Wales (and, to date, for the UK as a whole). It is situated in the northern sector of Cardigan Bay, 3 nm NW of Barmouth. Consequently, the habitat is restricted to an isolated location (MB102 C Report 16).
Physi	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					No Evid.	(L1)	1 - To date 'it is not known how long these structures have been there or how long they have taken to grow. If these structures were to be damaged..., the time taken for them to recover (re-grow) is unknown'. MB0102C report 16). It was therefore judged that there was insufficient information to assess sensitivity to abrasion pressures.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					No Evid.	(L1)	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					No Evid.	(L1)	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					No Evid.	(L1)	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	The Holden's Reef complex is the only known shallow water carbonate mound in Wales (and, to date, for the UK as a whole). It is situated in the northern sector of Cardigan Bay, 3 nm NW of Barmouth. Consequently, the habitat is restricted to an isolated location (MB102 C Report 16).
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - considered unlikely to be exposed to INS
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Not targeted directly
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M1)	(L1)	(L1)	(L1)	(M1)	(L1)	1 - Unlikely to be wholly removed but fragments could be removed

2.4 Coastal saltmarsh

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(VL3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.3)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(M1)	(L1)	1 - Feature would be moderately sensitive to sea level changes
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.3)
Hydrological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.3)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(VL3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.3)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(VL3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.3)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(VL3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.3)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3)		(H3)		(NS3) (NS5)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.3) 5 - Assessment supported by expert judgement in external review.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; Leuche et al 1998. Are effects but deemed to be positive so given high resistance score. Elements used in assessment: saltmarsh plant community
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H1)	(L1)	1 - Resistance based on no resistance to change in substrate
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1; Garbutt and Boorman, 2009, RSPB reports; Friess 2007, Bromberg Gedan et al 2009. Complete loss of habitat and therefore no recovery. Elements used in assessment: saltmarsh plant community

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	((M4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: wide saltmarsh community, plant community
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: wide saltmarsh community, plant community
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: wide saltmarsh community, plant community
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4)	(M4)	(M4)	(M4)	(M4) (M5)	(M4)	4 - based on expert judgement from workshop 1, CCW references, MarLIN. Elements used in assessment: wide saltmarsh community, plant community 5 - Based on expert judgement from CCW
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; CCW references, Baccer. Elements used in assessment: wide saltmarsh community, plant community
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1; Garbutt and Boorman 2009. Studies from realignment projects, Bangor University. Elements used in assessment: wide saltmarsh community, plant community
her physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Oth	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(H1)	(M1)	(M1)	(M1)	(M1)	1 - Spartina anglica highly invasive and may dominate marsh community
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: salicornia
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(NE4)	(NE4)	(NE4)	(NE4)	(NE4)	(L1)	4 - based on expert judgement from workshop 1. Elements used in assessment: saltmarsh plant community

2.5 Cold-water coral reefs

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H1)	(L1)	1 - Feature (Lophelia) would be highly sensitive to tide and ocean current changes
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L3) (N8)	(H8)	(VL3) (VL8)	(H8)	(H3) (H8)	(L3) (H8)	3 - Refer to Marlin evidence (see Annex H, Section 2.4) 8 - based on expert judgement from workshop 3, as the workshop delegastes represented considerable expertise in the field, MarLIN directed that the workshop assessments should take precedence in the matrix.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(N8)	(H8)	(VL8)	(H8)	(H8)	(H8)	8 - based on expert judgement from workshop 3

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L3)		(VL3)		(H3)	(M3)	3 - Refer to Marlin evidence (see Annex H, Section 2.4)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(NE3)		(NE3)		(NE3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.4)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(NE3)		(NE3)		(NE3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.4)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H8)		(H8)		(NS8)	(L8)	8 - based on expert judgement from workshop 3
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(L8)	(L8)	(VL8)	(L8)	(H8)	(L8)	8 - based on expert judgement from workshop 3
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(L8)	(H8)	(VL8)	(H8)	(H8)	(H8)	8 - based on expert judgement from workshop 3 (evidence from Robert et al. 2009).
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H3) (M4) (L8)	(M4) (H8)	(L4) (VL8)	(H4) (H8)	(M4) (H8)	(L3) (H8)	3 - Refer to Marlin evidence (see Annex H, Section 2.4) 4 - based on expert judgement from workshop 1; Sandra Brooke 2009 MEPF - torlerance based, Bioreef assessment Thomas Coramm - burial 8 - based on expert judgement from workshop 3
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L4) (L8)	(M4) (H8)	(VL4) (L8)	(H4) (H8)	(H4) (H8)	(H8)	4 - based on expert judgement from workshop 1 8 - based on expert judgement from workshop 3
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4) (N7)	(H4)	(VL4) (VL7)	(H4)	(H4) (H7)	(H4)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4) (N7)	(H4)	(VL4) (VL7)	(H4)	(H1) (H4) (H7)	(H4)	1 - Hall et al 2008 4 - based on expert judgement from workshop 1; Hall Spencer et al 2002, Roberts 2006 7 - based on expert judgement from workshop 2
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L4) (N7)	(H4)	(VL4) (VL7)	(H4)	(H4) (H7)	(H4)	4 - based on expert judgement from workshop 1; Gage 2005, Wheeler et al 2005 7 - based on expert judgement from workshop 2
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4) (N7)	(H4)	(VL4) (VL7)	(H4)	(H4) (H7)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: reef structure 7 - based on expert judgement from workshop 2
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	1. Feature considered to be Not Exposed to this pressure- due to lack of introduction pathways for INS.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1

2.6 Coral carbonate mounds

Pressure theme	Pressure	Benchmark	Sensitivity Assessment: Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	Not Assessed. Shoaling of the carbonate saturation horizon is thought to have major impacts on these habitats (Jason Hall-Spencer pers comm.)
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H1)	(L1)	1 - Feature would be highly sensitive to tide and ocean current changes
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
re/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L8)	(L8)	(L8)	(L8)	(H8)	(L8)	8 - based on expert judgement from Plymouth workshop
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L8)	(L8)	(L8)	(L8)	(H8)	(L8)	8 - based on expert judgement from Plymouth workshop
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L8)	(L8)	(L8)	(L8)	(H8)	(L8)	8 - based on expert judgement from Plymouth workshop

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshor	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H8)	(L8)	(H8)	(L8)	(NS8)	(L8)	8 - based on expert judgement from Plymouth workshop
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(L8)	(L8)	(L8)	(L8)	(H8)	(L8)	8 - based on expert judgement from Plymouth workshop
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N8)	(H8)	(N8)	(H8)	(H8)	(H8)	8 - based on expert judgement from Plymouth workshop
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(N4)	(L4)	(VL4)	(H4)	(H4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: coral sponges
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(VL4)	(H4)	(H4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: coral sponges
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(L4)	(VL4)	(H4)	(H4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: coral sponges
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(H4)	(VL4)	(H4)	(H4) (H8)	(H4)	4 - Based on expert judgement from workshop 1; Elements used in assessment: coral sponges 8 - supported by workshop 3, supporting evidence see Hall-Spencer et al. 2010.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: coral sponges
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: coral sponges
...er physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Oth	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	Not exposed to this pressure due to limited pathways for spread of INS.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NS	(L1)	1. Feature judged to be not sensitive as it is not a target species commercially expoited.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: coral sponges

2.7 Coral gardens

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L8)	(L8)	(L8)	(L8)	(H8)	(L8)	8 - Based on cold water coral reef assessments using expert judgement from workshop 3
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
re/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L8)	(L8)	(L8)	(L8)	(H8)	(L8)	8 - based on cold water coral reef assessments using expert judgement from workshop 3
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L8)	(L8)	(L8)	(L8)	(H8)	(L8)	8 - based on cold water coral reef assessments using expert judgement from workshop 3
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L8)	(L8)	(L8)	(L8)	(H8)	(L8)	8 - based on cold water coral reef assessments using expert judgement from workshop 3

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshor	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H8)	(L8)	(H8)	(L8)	(NS8)	(L8)	8 - based on cold water coral reef assessments using expert judgement from workshop 3
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(L8)	(L8)	(L8)	(L8)	(H8)	(L8)	8 - based on cold water coral reef assessments using expert judgement from workshop 3
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N8)	(H8)	(N8)	(H8)	(H8)	(H8)	8 - based on cold water coral reef assessments using expert judgement from workshop 3
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(N4)	(L4)	(VL4)	(H4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(VL4)	(H4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(L4)	(VL4)	(H4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
er physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Oth	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	1. Not exposed to this pressure benchmark -this judgement was made based on the consideration that there are limited pathways for invasion.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1

2.8 Deep sea sponge aggregations

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H1)	(L1)	1. Expert judgement at Workshop 3 considered that the sensitivities of this feature would be similar to cold-water coral reefs- hence we have based this assessment on that feature (see Annex G 2.5)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(N8)	(H8)	(VL8)	(H8)	(H8)	(H8)	H
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(N8)	(H8)	(VL8)	(H8)	(H8)	(H8)	8. Expert judgement at Workshop 3 considered that the sensitivities of this feature would be similar to cold-water coral reefs- hence we have based this assessment on that feature (see Annex G 2.5)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark due to the depth of occurrence. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (insh	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H8)		(H8)		(NS8)	(L)	8 - Expert judgement at Workshop 3 considered that the sensitivities of this feature would be similar to cold-water coral reefs- hence we have based this assessment on that feature (see Annex G 2.5)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(L8)	(L8)	(VL8)	(L8)	(H8)	(L8)	8. Expert judgement at Workshop 3 considered that the sensitivities of this feature would be similar to cold-water coral reefs- hence we have based this assessment on that feature (see Annex G 2.5)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4) (L8)	(H4) (H8)	(VL4) (VL8)	(H4) (H8)	(H4) (H8)	(H8)	4 - based on expert judgement from workshop 1. Elements used in assessment: deep sea sponges 8. Expert judgement at Workshop 3 considered that the sensitivities of this feature would be similar to cold-water coral reefs- hence we have based this assessment on that feature (see Annex G 2.5)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(N4) (L8)	(L4) (H8)	(VL4) (VL8)	(H4) (H8)	(H4) (H8)	(H8)	4 - based on expert judgement from workshop 1; Klitgaard and Tendal 2004. Elements used in assessment: deep sea
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4) (L8)	(L4) (H8)	(VL4) (L8)	(H4) (H8)	(H4) (H8)	(H8)	4 - based on expert judgement from workshop 1; Conway et al 2005. Elements used in assessment: deep sea sponges 8. Expert judgement at Workshop 3 considered that the sensitivities of this feature would be similar to cold-water coral reefs- hence we have based this assessment on that feature (see Annex G 2.5)
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: deep sea sponges
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: deep sea sponges
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: deep sea sponges

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: deep sea sponges
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological p	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: deep sea sponges

2.9 Egg wrack beds

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(VL3)		(L3)		(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.5)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(NS1) (H5)	(L)	Although expert review suggested sensitivity to emergence may be high, it was considered that the feature refers to floating egg-wrack and that this would not be sensitive to changes in the pressure benchmark as the beds would be unaffected.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(H5)	(L)	5 - Based on expert judgement by external review.
rological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H3)		(H3)		(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.5)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L5)	(L)	
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(VL3)		(L3)		(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.5)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(L3)		(M3)		(M3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.5)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hyd	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(VL3)		(L3)		(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.5)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3)		(H3)		(NS3) (NS5)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.5) 5 - Supported in review by external experts.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(L4)	(L4)	(VL4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: Ascophyllum
hysical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(H4)	(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1; Jenkins et al., 2004. Assuming a change from rock substrate e.g. gravel - Feature only ever found on rock so high sensitivity. Elements used in assessment: Ascophyllum

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pl	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N4)	(H4)	(N4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: Ascophyllum
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(VL3) (N4)	(L4)	(L3) (L4)	(H4)	(H3) (H4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 2.5) 4 - based on expert judgement from workshop 1. Elements
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(L4)	(H4)	(H4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: Ascophyllum
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(H4)	(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1; Ascophyllum nodosum has long recovery times (Jenkins et al., 2004). Elements used in assessment: Ascophyllum
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(NE4)	(NE4)	(NE4)	(NE4)	(NE4)	(L)	4 - based on expert judgement from workshop 1; MEPS 2009. Elements used in assessment: Ascophyllum
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: Ascophyllum
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1; Jenkins et al., 2004. Elements used in assessment: Ascophyllum nodosum
ner physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Oth	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(H1)	(M1)	(H1)	(M1)	(H1)	1 - Species such as Sargassum can be highly invasive and dominate algal canopy
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H4)	(H4)	(H1) (M4)	(H4)	(NS1) (L4)	(H4)	1 - It was judged based on the workshop assessments that recovery from a minor impact should be assessed as high and therefore the assessments should be 'Not Sensitive'. This was adopted as it was understood that the beds are not the target of a commercial fishery. 4 - based on expert judgement from workshop 1; Fegley 2001, Boaden and Dring 1980, Kelly 2001. Elements used in assessment: Ascophyllum. It was judged that the
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - commercial harvesting activity in this habitat is likely to be very selective for target species

2.10 Estuarine Rocky Habitats

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS7)	(L1)	7 - based on expert judgement from workshop 2
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(H5)	(L)	5 - Based on expert judgement by external review.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H1)	(M1)	(H1)	(M1)	(NS1)	(M1)	Estuaries are generally sheltered and changes in wave exposure likely to be relatively small
Hydrological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(M1)	(M1)	(H1)	(M1)	(L1)	(M1)	1 - Feature would have low sensitivity to local temperature changes
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L7)	(L7)	(H7)	(L7)	(L5) (L7)	(L7)	5 - Based on expert judgement from CCW 7 - based on expert judgement from workshop 2
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H7)	(L7)	(H7)	(L7)	(NS7)	(L7)	7 - based on expert judgement from workshop 2
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(L7)	(L7)	(M7)	(L7)	(M7)	(L7)	7 - based on expert judgement from workshop 2
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H7)	(L7)	(H7)	(L7)	(NS7)	(L7)	7 - based on expert judgement from workshop 2

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS5)	(L)	5 - supported in review by external experts 7 - based on expert judgement from workshop 2
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(L7)	(L7)	(M7)	(L7)	(M7)	(L7)	7 - based on expert judgement from workshop 2
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H4) (H7)	(H4) (L7)	(H4) (H7)	(H4) (L7)	(NS4) (NS7)	(H4) (L7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(H4) (M7)	(H4) (L7)	(H4) (H7)	(H4) (L7)	(NS4) (L7)	(H4) (L7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2. Reconciling these two assessments was problematic as no supporting evidence was supplied by experts, therefore it was decided to present the most precautionary measure in the matrix although acknowledging that this may overestimate sensitivty.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4) (M7)	(L4) (L7)	(M4) (H7)	(L4) (L7)	(M4) (L7)	(L4) (L7)	It was judged that the effects of this pressure would be similar to the assessment made in Workshop 1 for shallow abrasion. The most precautionary assessment was used in the matrix (see above).
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4) (M7)	(L4) (L7)	(M4) (H7)	(L4) (L7)	(M4) (L7)	(L4) (L7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2. Reconciling these two assessments was problematic as no supporting evidence was supplied by experts, therefore it was decided to present the most precautionary measure in the matrix although acknowledging that this may overestimate sensitivty.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical p	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(M5)	(L)	5 - Based on expert judgement by external review.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L7)	(L7)	(VL7)	(L7)	(H7)	(L7)	7 - based on expert judgement from workshop 2
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(M7)	(L7)	(H7)	(L7)	(L7)	(L7)	7 - based on expert judgement from workshop 2 - based on commercial harvesting of littorinids?
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - harvesting of littorinids is selective; non-target impacts could vary depending on how fishery is prosecuted (e.g. trampling, over-removal of grazers etc)

2.11 File shell beds

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1. At the pressure benchmark this feature was judged to have low sensitivity, the bivalves form dense nests which were judged to have medium resistance to being broken up or damaged by increased water flow and to have a high recovery.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.7)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.7)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1. At the pressure benchmark this feature was judged to have low sensitivity, the bivalves form dense nests which were judged to have medium resistance to being broken up or damaged by increased water flow and to have a high recovery.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3)		(H3)		(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.7)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(L4)	(H4)	(L4)	(H4)	(H4) (H8)	(H4)	4 - based on expert judgement from workshop 1; Wadden sea and Strangford loch examples. Removal could lead to loss of habitat, wont be able to recolonise. 8 - supported by assessments made by Jason Hall-Spencer
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(L3) (L4)	(L4)	(M3) (VL4)	(M3) (L4)	(M3) (H4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 2.7) 4 - based on expert judgement from workshop 1 As the project specification was to develop an expert judgement based approach we have presented the workshop assessment in the matrix, however compared with MarLIN's evidence based approach, this may overestimate sensitivity.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(VL4)	(L4)	(H4) (H8)	(L4)	4 - based on expert judgement from workshop 1 8 - supported by assessments made by Jason Hall-Spencer
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(M4)	(VL4)	(M4)	(H4) (H8)	(M4)	4 - based on expert judgement from workshop 1; papers on removal 8 - supported by assessments made by Jason Hall-Spencer
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(M4)	(VL4)	(M4)	(H4) (H5)	(M4)	4 - based on expert judgement from workshop 1 5 - supported in review by external experts
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(M4)	(M4)	(M4)	(M4) (M8)	(M4)	4 - based on expert judgement from workshop 1 8 - supported by assessments made by Jason Hall-Spencer
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(M4)	(VL4)	(M4)	(H4) (H8)	(M4)	4 - based on expert judgement from workshop 1; removal of species and habitat so difficult to recolonise. 8 - supported by assessments made by Jason Hall-Spencer

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ssures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pres	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1; smothering impacts e.g. New Zealand and Strangford Loch examples
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(NE4)	(L)	4 - based on expert judgement from workshop 1; feature not targeted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1) (H4)	(L4)	(L1) (H4)	(L4)	(H1) (NS4)	(L4)	1 - feature potentially reoved as by-catch; slow to recover (plymouth Ref); Trigg & Moore, 2009 4 - based on expert judgement from workshop 1; assume feature stays in tact with removal of non-taregt species

2.13 Fragile sponge and anthozoan communities on subtidal rocky habitats

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(M1)	(L1)	1 - Feature would be moderately sensitive to tide and ocean current changes
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.8)
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.8)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L3)		(L3)		(H3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.8)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.8)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(L3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.8)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3)		(H3)		(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.8)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4) (L7)	(L4) (L7)	(VL4) (M7)	(L4) (L7)	(H4) (M7)	(L4) (L7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2. As both of these differeing assessments were of low confidence, the most precautionary assessment was presented in the matrix, however, according to expert judgement this assessment may overestimate the sensitivity of this feature.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(L3) (N4)	(L4)	(M3) (VL4)	(L4)	(M3) (H4)	(L4)	3- based on MarLIN information 4 - based on expert judgement from workshop 1. As these assessments differ, the most precautionary assessment was presented in the matrix, however, according to the evidence-based review undertaken by MarLIN, this assessment may overestimate the sensitivity of this feature.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(VL4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(H1)	(L1)	1 - This assessment was based on those made for heavy and light abrasion- if the feature is highly sensitive to those pressures it is logical to assume that it is also highle sensitive to penetration and disturbance below the surface.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4) (L7)	(H4) (L7)	(VL4) (L7)	(L4) (L7)	(H4) (H5) (H7)	(L4) (L7)	4 - based on expert judgement from workshop 1 5 - CCW 7 - based on expert judgement from workshop 2
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L4) (L7)	(H4) (L7)	(L4) (L7)	(H4) (L7)	(H4) (H7)	(H4) (L7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(H1)	(L1)	1 - This assessment was based on those made for heavy and light abrasion- if the feature is highly sensitive to those pressures it is logical to assume that it is also highle sensitive to penetration and disturbance below the surface.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-M1)	(L1)	(L-M1)	(L1)	(M-H1)	(L1)	1- component biotopes may be exposed to various INS and some features slow to recover
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(N4)	(L4)	(VL4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1

2.14 Intertidal mudflats

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS5)	(L)	5 - Based on expert judgement from review
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(H5)	(L)	5 - Based on expert judgement from review
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.11)
s (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L4)	(H4)	(H4)	(H4)	(L4)	(H4)	4 - based on expert judgement from workshop 1 ; Fawley power station papers, discharge studies Medway.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L4)	(H4)	(H4)	(H4)	(L4) (L5)	(H4)	4 - based on expert judgement from workshop 1; assume worst case scenario for open coast (rather than estuaries). Noted that benchmark seems unlikely to occur especially for whole year. 5 - Based on expert judgement from review
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H4)	(H4)	(H4)	(H4)	(NS4) (NS5)	(H4)	4 - based on expert judgement from workshop 1 ; Severn barrage studies 5 - Assessment was supported by expert reviewers

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(M3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.11)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(M3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.11)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS3) (NS5)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.11) 5 - Based on expert judgement from review
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(M4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1 ; Medway study on algal blooms, Southern water in Portsmouth harbour. Elements used in assessment: mud, infaunal invertebrates, algal mats and emergence regime.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H1)	(L1)	1 - Feature would be highly sensitive to a change in seabed type
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: mud, infaunal invertebrates, algal mats and emergence regime.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L4)	(H4)	(H4)	(H4)	(L4)	(H4)	4 - based on expert judgement from workshop 1 ; work on EIAs for windfarms - cables through intertidal mudflats. Elements used in assessment: mud, infaunal invertebrates, algal mats and emergence regime.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(H4)	(H4)	(H4)	(L4)	(H4)	4 - based on expert judgement from workshop 1 ; work on EIAs for windfarms - cables through intertidal mudflats. Elements used in assessment: mud, infaunal invertebrates, algal mats and emergence regime.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(M4)	(H4)	(H4)	(H4)	(L4)	(H4)	4 - based on expert judgement from workshop 1 ; Thames cockle dredging, Kent and Essex 20 year sensitivity surveys. Piersma et al 2001. Kaiser et al. 2001. Elements used in assessment: mud, infaunal invertebrates, algal mats and emergence regime.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(H4)	(H4)	(H4)	(L4)	(H4)	4 - based on expert judgement from workshop 1 ; Thames cockle dredging, Kent and Essex 20 year sensitivity surveys. Piersma et al 2001. Kaiser et al. 2001. Elements used in assessment: mud, infaunal invertebrates, algal mats and emergence regime.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(H4)	(H4)	(M4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: mud, infaunal invertebrates, algal mats and emergence regime.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M4)	(H4)	(VL4)	(H4)	(M4)	(H4)	4 - based on expert judgement from workshop 1 ; studies in Essex on Pacific oysters (plus Holland, France, Exe estuary). Elements used in assessment: mud, infaunal invertebrates, algal mats and emergence regime.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L4)	(H4)	(M4)	(H4)	(M4)	(H4)	4 - based on expert judgement from workshop 1 ; Gordon Watson et al 2007. Assume footprint of pressure. Elements used in assessment: mud, infaunal invertebrates, algal mats and emergence regime.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1 ; Johnson et al. 2008, Kaiser et al. 2001. Fowler 2001 ; examples from cockle fisheries e.g. Wash. Not many studies of effects of turned mud on non-target fauna. Elements used in assessment: mud, infaunal invertebrates, algal mats and emergence regime.

2.15 Intertidal underboulder communities

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(NS5)	(L)	5 - Based on expert judgement from review.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS5)	(L)	5 - Based on expert judgement from review.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(M5)	(L)	5 - Based on expert judgement from review.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS5)	(L)	5 - Based on expert judgement from review.
al changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(M3)		(H3)		(L3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.12)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(M3)		(H3)		(L3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.12)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(M3)		(H3)		(L3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.12)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(M3)		(H3)		(L3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.12)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrologic	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS1)	(L1)	1 - Wave exposure at the pressure benchmark is not judged sufficient to alter physical structure of habitat, biological assemblage is sheltered.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3)		(H3)		(NS3) (M5)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.12) 5 An expert reviewer suggested that there was some variation intertidal underboulder communities according to water clarity. Due to this uncertainty a decision of Not Assessed was used in the matrix.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; assuming that the high energy environment would remove the sediment deposition aspect of this pressure. Increased C would possibly change the species composition but the comminity would still be recognisable as an underboulder community.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(H4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(N3) (H4)	(L4)	(H3) (M4)	(L4)	(M3) (L4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 2.12) 4 - based on expert judgement from workshop 1
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(M4)	(L4)	(M4) (M5)	(L4)	4 - based on expert judgement from workshop 1 5 - Based on expert judgement from review.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L1)	(L1)	(L1)	(L1)	(H1)	(L1)	1 - The benchmark refers to structural damage, in this case the movement of boulders. Fragile organisms would be crushed or exposed, there is little information on the sensitivity of these but it was judged that there would be habitat alteration and the loss of 25%-75% of organisms (although towards the lower part of this range). The change in habitat configuration would be long-term of permanent but the underboulder biological association could recover to an extent, providing there are still boulders, rhowever, where structural damage reduces habitat complexity recovery may be limited. recovery was therefore assessed to be low.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - It was judged that heavy abrasion pressure would be similar to the light abrasion pressure assessed at workshop 1, this assessment is therefore based on that.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; We are assessing the sensitivity against turning boulders for harvesting of winkles etc. Assuming that some boulders are turned and not turned back. The impact would be heavily dependent on the intensity and fequency of turning

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological p	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Risks from several INS to this feature
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L1)	(L1)	(M1)	(L1)	(M1) (M5)	(L1)	1 - possible target fishery for littorinids 5 - Based on expert judgement from review.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Selective extraction of littorinids may not affect wider assemblage depending on factors such as trampling, intensity etc

2.16 Inshore deep mud with burrowing heart urchins

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1. Assessed as no sensitivity to this pressure benchmark- based on the assumption that the change in water flow rates do not lead to erosion or the mud habitats that characterise this habitat- Mud sediments can have cohesive properties and therefore have some resistance to erosion. The characterising species (heart urchins) live buried in the sediment and therefore have some resistance to surface changes. Sublethal effects may occur where food deposition rates are affected, however these changes should be assessed on a site-specific basis.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1. Assessed as no sensitivity to this pressure benchmark- based on the assumption that the change in wave exposure do not lead to erosion or the mud habitats that characterise this habitat- Mud sediments can have cohesive properties and therefore have some resistance to erosion. The characterising species (heart urchins) live buried in the sediment and therefore have some resistance to surface changes. Sublethal effects may occur where food deposition rates are affected, however these changes should be assessed on a site-specific basis.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(M3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.10)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1. Assessed as no sensitivity to this pressure benchmark- based on the assumption that the change in water flow rates do not lead to erosion or the mud habitats that characterise this habitat- Mud sediments can have cohesive properties and therefore have some resistance to erosion. The characterising species (heart urchins) live buried in the sediment and therefore have some resistance to surface changes. Sublethal effects may occur where food deposition rates are affected, however these changes should be assessed on a site-specific basis.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1. Assessed as no sensitivity to this pressure benchmark- based on the assumption that the change in wave exposure does not lead to erosion or the mud habitats that characterise this habitat- Mud sediments can have cohesive properties and therefore have some resistance to erosion. The characterising species (heart urchins) live buried in the sediment and therefore have some resistance to surface changes. Sublethal effects may occur where food deposition rates are affected, however these changes should be assessed on a site-specific basis.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.10)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(NS1)	(L1)	1 - muddy environment, deposit feeders can utilise dditional food source, mud sediments can have high organic comntents
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H4)	(L4)	(H4)		(NS3) (NS4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 2.10) 4 - based on expert judgement from workshop 1
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N1) (N4)	(L4)	(M1) (M4)	(L4)	(M1) (M4)	(L4)	1 & 4 Based on expert judgement from workshop 1 and review, the characterising species Brissopsis lyrifera has a fragile test and it was therefore judged that the species would have no resistance to subsurface disturbance and damage.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - Abrasion that disturbed the surface to a depth of 25mm was judged to kill less than 25% of the population of Brissosis lyrifera which lives buried in sediment to a depth of 10cm. The species was therefore judged to have medium resistance.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M 1)	(L1)	(H 1)	(L1)	(L1)	(L1)	1 - The characterising species Brissopsis lyrifera is an infaunal species that lives buried in the sediment to a depth of 10cm. It was judged that this environmental position would afford protection from abrasion at the surface sediment and that resistance to the pressure would be medium.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - No significant INS impacts recorded in this habitat
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Target species unlikely to be characterizing for biotopes and effects on biotope assemblage may be minor
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; related to dredges and trawls

2.17 Kelp and seaweed communities on sublittoral sediment

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					(NS1)	(L1)	1 - Assessment based on expert judgement from workshop 1 and supported by online biotope description from JNCC which reports that the feature is found in a range of salinities from 18ppt-35ppt (see references).
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(H1)	(H1)	(H1)	(NS1)	(H1)	1 - Assessment of not sensitive supported by online biotope description from JNCC which reports that the feature is found in areas where tidal streams vary from very weak to moderately strong (see references).
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(NS1)	(L1)	1 - An increase in ASL may alter zonation but overall the spatial extent and general composition of this feature is not predicted to be impacted by this change
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H1)	(H1)	(H1)	(H1)	(NS1)	(H1)	1 - Assessment of not sensitive supported by online biotope description from JNCC which reports that the feature is found in locations where wave exposure varies from extremely sheltered to moderately exposed (see references).
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - based on expert judgement from workshop 1; Barton et al, Dayton review. Elements used in assessment: Laminaria saccarina.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - Assessment based on expert judgement from workshop 1. Saccarina grows in estuaries so should be tolerant to salinity changes. Supported by online biotope description from JNCC which reports that the feature is found in a range of salinities from 18ppt-35ppt (see references). Elements used in assessment: Laminaria saccarina.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(H1)	(H1)	(H1)	(NS1)	(H1)	1 - Assessment of not sensitive supported by online biotope description from JNCC which reports that the feature is found in areas where tidal streams vary from very weak to moderately strong (see references).
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(M4)	(L4)	(H4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: Laminaria saccarina.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H1)	(H1)	(H1)	(H1)	(NS1)	(H1)	1 - Assessment of not sensitive supported by online biotope description from JNCC which reports that the feature is found in locations where wave exposure varies from extremely sheltered to moderately exposed (see references).
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(M3) (M4)	(L4)	(H3) (H4)	(H4)	(L3) (L4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 2.13) 4 - based on expert judgement from workshop 1; Burrows, Connor et al. Elements used in assessment: Laminaria saccarina.
	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical changes	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1; Pearson and Rosenberg 1978. Elements used in assessment: Laminaria saccarina.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M1)	(L1)	1 - Feature would be moderately sensitive to a change in seabed type
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
...age	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H4)	(M4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1; based on observations of some species surviving being buried. Resistance - some algae would have high resistance and would be ok, but associated fauna e.g. sponges, ascidians included in some of the biotopes would expect mortality. Recovery - Key structural elements would recover relatively quickly (<2years) but other elements would be longer e.g. modiolus. Elements used in assessment: Laminaria saccarina.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(M4)	(M4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: Laminaria saccarina.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical dam	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(M4)	(L4)	(H4)	(M4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; Burrows 1960. Dependent on nature of substratum , if stones attached to move around. Elements used in assessment: Laminaria saccarina.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4)	(L4)	(H4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop 1; thought that trawling would avoid these biotopes/habitat. Elements used in assessment: Laminaria saccarina.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(L4)	(H4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop 1; observations of algae on creel pots, possibly ripped off and/or growing in pots. Elements used in assessment: Laminaria saccarina.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(M4)	(H4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; Burrows 1960. Dependent on time of year. Elements used in assessment: Laminaria saccarina.
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(H1)	(M1)	(H1)	(M1)	(H1)	1 - Species such as Sargassum and Undaria can be very invasive, dominating algal canopy
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1) (NE4)	(L1)	(H1) (NE4)	(L1)	(NS1)	(L1)	1 - feature unlikely to be targeted directly, but some other forms of commercial harvesting may occur 4 - based on expert judgement from workshop 1; judged to be not relevant in the UK. Elements used in assessment: Laminaria saccarina.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1; creeling for velvet swimming crabs may result in entanglement of feature. Elements used in assessment: Laminaria saccarina.

2.18 Littoral chalk communities

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS5)	(L)	5 - Based on expert judgement by external review.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(H5)	(L)	5 - Based on expert judgement by external review.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS5)	(L)	5 - Based on expert judgement by external review.
Hydrological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(M1)	(L1)	1 - Feature would be moderately sensitive to local changes in temperature
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L5)	(L)	5 - Based on expert judgement by external review.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS5)	(L)	5 - Based on expert judgement by external review.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(L4)	(L)	4 - based on expert judgement from workshop 1
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS5)	(L)	5 - Based on expert judgement by external review.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(H5)	(L)	5 - Based on expert judgement by external review.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H1)	(L1)	1 - Feature would be highly sensitive to a change in seabed type
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(M1)	(L1)	1 - As many of the constituent biotopes of this habitat type are characterised by macroalgae the assessments made for Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17) and Tide swep alga communities (see Annex G, Section 2.40).
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(M1)	(L1)	1 - As many of the constituent biotopes of this habitat type are characterised by macroalgae the assessments made for Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17) and Tide swep alga communities (see Annex G, Section 2.40).
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - component biotopes at risk from several INS
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - possible target fishery for littorinids
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Selective extraction of littorinids may not affect wider assemblage depending on factors such as trampling, intensity etc

2.19 Maerl Beds

Pressure theme	Pressure	Benchmark	Sensitivity Assessment: Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
Climate change	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
Climate change	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Changes in water flow at the pressure benchmark are not considered to have an impact on this feature.
Climate change	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Maerl can occur in the low intertidal, but is generally a shallow subtidal feature, changes in emergence at the pressure benchmark were not considered to impact this feature.
Climate change	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1- Maerl occurs in sheltered areas where wave action is strong enough to remove fine sediments, a change in wave exposure at the pressure benchmark level is not considered to impact this feature.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L1)		(L1)		(H3) (H8)	(L1)	3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.15) 8 - Based on expert judgement from workshop 3
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(N1)		(VL1)		(H3) (H8)	(M1)	3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.15) 8 - Based on expert judgement from workshop 3
ore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Changes in water flow at the pressure benchmark are not considered to have an impact on this feature.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (insh	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1- Maerl occurs in sheltered areas where wave action is strong enough to remove fine sediments, a change in wave exposure at the pressure benchmark level is not considered to impact this feature.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(H8)	(L)	8 - Based on expert judgement from workshop 3
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N7)	(L7)	(VL7)	(M7)	(H7)	(L7)	7 - based on expert judgement from workshop 2
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N1)	(H1)	(VL1)	(H1)	(H1)	(H1)	1 - Maerl is judged be highly sensitive to loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(N7)		(L7)		(H3) (H8)	(L)	3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.15) 8 - Based on expert judgement from workshop 3
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(H1)	(L1)	1 - based on assessment for low siltation.
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N1) (N L7)	(H1)(M 7)	(VL1) (VL7)	(H1) (M7)	(H1) (H7)	(H1) (M7)	1 - Based on expert judgement of maerl general characteristics, feature occurs on surface so would be highly exposed to penetration and disturbance. Maerl species in general are fragile and do not tolerate burial. Maerl species are very slow growing species, hence recovery times would be long. 7 - based on expert judgement from workshop 2; Jason Hall-Spencer papers
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N-L7)	(M7)	(VL7)	(M7)	(H1) (H7)	(M7)	1 - Based on work carried out by Hall et al 2008, maerl is highly sensitivie to heavy abrasion pressures. 7 - based on expert judgement from workshop 2; Jason Hall-Spencer papers e.g. Hall-Spencer and Moore 2000.
Physical damage	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L7)	(L7)	(L7)	(L7)	(H7)	(L7)	7 - based on expert judgement from workshop 2
Physical damage	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N7)	(M7)	(VL7)	(M7)	(H5) (H7)	(M7)	5 - Based on expert judgement by external review. 7 - based on expert judgement from workshop 2

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(M1)	(L1)	(L1)	(H1)	(L1)	1- OSPAR background document for maerl identifies Crepidula as threat
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(H1)	(L1)	1 - Based on expert judgement supplied to the workshops
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(H1)	(L1)	1 - Maerl can be impacted by extraction activities

2.20 Maerl or course shell gravel with burrowing sea cucumbers

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
Climate change	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
Climate change	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(M1)	(H1)	(M1)	(NS1)	(M1)	1 - Neopentadactyla mixta found in areas where tidal streams are strong therefore this feature is considered to be not sensitive to increases in water flow corresponding to the pressure benchmark
Climate change	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Maerl can occur in the low intertidal, but is generally a shallow subtidal feature, changes in emergence at the pressure benchmark were not considered to impact this feature.
Climate change	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1- Maerl occurs in sheltered areas where wave action is strong enough to remove fine sediments, a change in wave exposure at the pressure benchmark level is not considered to impact this feature.
ore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L1)		(L1)		(H3) (H8)	(L1)	3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.16) 8 - Based on expert judgement from workshop 3
ore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(N1)		(VL1)		(H3) (H8)	(M1)	3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.16) 8 - Based on expert judgement from workshop 3
ore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Changes in water flow at the pressure benchmark are not considered to have an impact on this feature.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (insh	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1- Maerl occurs in sheltered areas where wave action is strong enough to remove fine sediments, a change in wave exposure at the pressure benchmark level is not considered to impact this feature.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(H8)	(L1)	8 - Based on expert judgement from workshop 3
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N1)	(L1)	(VL1)	(M1)	(H1)	(L1)	1 - Feature would be highly sensitive to a change in seabed type
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N1)	(H1)	(VL1)	(H1)	(H1)	(H1)	1 - Feature would be highly sensitive to loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(N7)		(L7)		(H3) (H8)	(M7)	3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.15) 8 - Based on expert judgement from workshop 3
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(H1)	(L1)	1 - based on assessment for low siltation.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N1) (N L7)	(H1)(M 7)	(VL1) (VL7)	(H1) (M7)	(H1) (H7)	(H1) (M7)	1 - Based on expert judgement of maerl general characteristics, feature occurs on surface so would be highly exposed to penetration and disturbance. Maerl species in general are fragile and do not tolerate burial. Maerl species are very slow growing species, hence recovery times would be long. 7 - based on expert judgement from workshop 2; Jason Hall-Spencer papers
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N-L7)	(M7)	(VL7)	(M7)	(H1) (H7)	(M7)	1 - Based on work carried out by Hall et al 2008, maerl is highly sensitivie to heavy abrasion pressures. 7 - based on expert judgement from workshop 2; Jason Hall-Spencer papers e.g. Hall-Spencer and Moore 2000.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L7)	(L7)	(L7)	(L7)	(H7)	(L7)	7 - based on expert judgement from workshop 2
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N7)	(M7)	(VL7)	(M7)	(H5) (H7)	(M7)	5 - Based on expert judgement from CCW 7 - based on expert judgement from workshop 2

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(M1)	(L1)	(L1)	(H1)	(L1)	1- OSPAR background document for maerl identifies Crepidula as threat
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(H1)	(L1)	1 - Based on assesment for maerl beds (G 2.19)
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(H1)	(L1)	1 - Based on assesment for maerl beds (G 2.19)

2.21 Horse mussel beds

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(M1)	(L1)	1 - Feature would be moderately sensitive to tide and ocean current changes
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(M3)		(L3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.9)
rological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L3)		(L3)		(H3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 2.9)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L3)	(M3)	3 - Refer to Marlin evidence (see Annex H, Section 2.9)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(M3)		(L3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.9)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hyd	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(M3)		(L3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.9)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.9)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; no anoxia by this benchmark so possibly positive effects.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(L4)	(H4)	(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1; Wadden sea and Strangford loch examples. Removal could lead to loss of habitat, wont be able to recolonise.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M3) (L4)	(M4)	(L3) (M4)	(M4)	(M3) (M4)	(L3) (M4)	4 - based on expert judgement from workshop 1; Strangford Loch sediment traps out now so will have more evidence soon
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; see Holt, 1998 reference
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(M4)	V(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; papers on removal
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(M4)	V(L4)	(M4)	(H4) (H5)	(M4)	4 - based on expert judgement from workshop 1 5 - based on expert review by CCW
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; general biogenic reef references on recolonisation
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(M4)	V(L4)	(M4)	(H4) (H5)	(M4)	4 - based on expert judgement from workshop 1 5 - based on expert review by CCW
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1; smothering impacts e.g. New Zealand and Strangford Loch examples
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(N4)	(H4)	(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1)	(L1)	(L1)	(L1)	(H1) (NS4) (M5)	(L1)	1 - removal of Modiolus will remove many of the associated features; recovery of the associated features will only occur once the Modiolus bed recovers. Assume reef wasn't actually removed in the process. Could reduce competition and aid the reef

2.22 Mud habitats in deep water

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km^2 or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NA	(L1)	No Assessment was supplied for this pressure x feature combination at workshops or in external review.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km^2 or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; Nicolette *et al.* 2003, Rosenberg 1978
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(N4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(VL4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; Magorian *et al.* 1994, Kaiser *et al.* 2006 MEPS - Refs therein, Hedin *et al.* 2006, Canadian Journal of Fisheries and Aquatic Science
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; Magorian *et al* . 1994, Kaiser *et al* . (2006) MEPS - Refs therein, Kaiser *et al.* 2000 Journal of Animal Ecology 5 - Based on expert judgement by external review.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; Resistance based on reference of creeling

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical d	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4) (N7)	(M4) (H7)	(L4) (M7)	(M4) (H7)	(H4) (H5) (M7)	(M4) (H7)	4 - based on expert judgement from workshop; Recoverability is based on the assumption that the sediment would return prior to the recovery of the biological community. Recoverability based on M. modiolus beds and associated fauna - mussels themselves would recover 1-2years, biogenic reef as a whole would be >2years 5 - Based on expert judgement by external review. 7 - based on expert judgement from workshop 2. Elements used in assessment: M. modiolus beds and associated fauna. The differences in the sensitivity assessments are driven by different recovery assessments- in this case the most precautionary assessment was presented in the matrix- although this may overestimate sensitivity. it should be noted that expert reviewer supported this higher sensitivity assessment.
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H4)	(L4)	(M4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop; Bradshaw et al. (2003/4). For example, removal of scallops via dredging would not change the character of the habitat as a whole.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L4)	(H4)	(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop; Kaiser *et al.* (2006) - Refs therein

2.23 *Musculus discors* beds

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
Climate change	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(M1)	(L1)	1 - Feature would be moderately sensitive to tide and ocean current changes
Climate change	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
hore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H3)		(H3)		(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.17)
hore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.17)
hore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(M3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.17)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.17)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(VL3) (L4)	(L4)	(M3) (L4)	(L4)	(M3) (H4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 2.17) 4 - based on expert judgement from workshop 1. As the project specification was to develop an expert judgement based approach we have presented the workshop assessment in the matrix, however compared with MarLIN's evidence based approach, this may overestimate sensitivity.
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
Physical damage	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
Physical damage	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M5)	(L1)	5 - Based on expert judgement by external review.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - susceptible to removal in trawl gears

2.24 Northern seafan communities

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(H1)	(L1)	1 - There is concern that a 2°C rise in temperature could initiate the decline of Northern Sea fan communities from Scottish Lochs (Hill et al. 2010, references therein), therefore the feature is assessed to be highly sensitive to temperature change.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(H1)	1 - JNCC online biotope descriptions (see references) report that Northern Sea Fan biotopes occur in a tidal stream range of sheltered to moderately strong, this feature was therefore assessed to be not sensitive to the pressure benchmark.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NE1)	(H1)	1 - JNCC online biotope descriptions (see references) report that Northern Sea Fan biotopes occur in a wave exposure range of sheltered to extremely exposed, this feature was therefore assessed to be not sensitive to the pressure benchmark.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(H1)	(L1)	1 - Feature would be highly sensitive to local changes in temperature

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NA	(L)	No Assessment was supplied for this pressure x feature combination at workshops or in external review.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(H1)	1 - JNCC online biotope descriptions (see references) report that Northern Sea Fan biotopes occur in a tidal stream range of sheltered to moderately strong, this feature was therefore assessed to be not sensitive to the pressure benchmark.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NE1)	(H1)	1 - JNCC online biotope descriptions (see references) report that Northern Sea Fan biotopes occur in a wave exposure range of sheltered to extremely exposed, this feature was therefore assessed to be not sensitive to the pressure benchmark.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS1)	(L1)	1 - A heavily silted variant of the biotope occurs in Ireland-CarSwi.Aglo, given the existence of this variant it was considered that the feature is able to tolerate increased turbidity at the pressure benchmark although some components on the biotope may be affected.
...anges	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical ch	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(M4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(L4)	(L4)	(M4)	(M4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; used pink sea fans as proxy in Skomer. Elements used in assessment: pink sea-fans
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; used pink sea fans as proxy in Skomer. Elements used in assessment: pink sea-fans
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: pink sea-fans
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; used pink sea fans as proxy in Skomer. Elements used in assessment: pink sea-fans
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(N4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; used pink sea fans as proxy in Skomer. Elements used in assessment: pink sea-fans

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: pink sea-fans
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(M1)	(M1)	(L1)	1 - Potential for interaction between feature and INS
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Not targeted directly
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1)	(M1)	(M1)	(M1)	(M1)	(M1)	1 - susceptible to removal from trawling activities

2.25 Saline lagoons

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(NE4)		(NE4)		(NE4) (NE10)	(L1)	4&10 -As saline lagoons tend to occur in sheltered areas it was considered- based on expert review and the workshop that it was appropriate to assess this as Not Exposed- however this exposure could change in the future (Ian Reach, Natural England, pers comm.)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(H5)	(L5)	5 - Based on expert judgement, resistance and resilience scores were not provided or supporting evidence and hence the assessment confidence is low.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(NE4)		(NE4)		(NE4)	(L)	4 - based on expert judgement from workshop 1 as saline lagoons occur in sheltered areas it was thought that they should be assessed as not exposed.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; English Nature reports (Sussex). Presumed daily/seasonal natural temperature changes of 5oC or more

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(H4)	(M4)	(H4)	(M4)	(NS4) (M5) (L10)	(M4)	4 - based on expert judgement from workshop 1; presumed that natural salinity fluctuations over a year can be from 10-40units without major changes to physio-chemical properties of habitats 5 - Based on expert judgement from external review. 10- The assessment varied from NS to medium, in reviewing these assessments, expert judgement was that while species are able to tolerate various salinity range shifts - the conservation value of a lagoon is determined by presence of its specialist species. The flux of salinity uner the M benchmark could be enough to knock-out some specialists. Recruitment of specialists into individual lagoons is so poorly understood that a knock-out event could be permanent, even if the salinity returns to the 'normal' range for that lagoon within 1 year. Therefore it was suggested that sensitivity should be low (Ian Reach, Natural England, pers comm).. Supporting reference sinclude Bamber, Gilliland & Shardlow 2001 Saline Lagoons: A guide to their management...; Bamber 2009 Coastal saline lagoons and the WFD. NE report.-accepted-updated
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(NE4)		(NE4)		(NE4)	(L)	10 -As saline lagoons tend to occur in sheltered areas it was considered- based on expert review and the workshop that it was appropriate to assess this as Not Exposed-however this exposure could change in the future (Ian Reach, Natural England, pers comm.)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(NE4)		(NE4)		(NE4)	(L)	4 - based on expert judgement from workshop 1, it was considered that saline lagoons due to the physically protected nature of environment would not be exposed to changes in emergence levels.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(NE4)		(NE4)		(NE4)	(L)	4 - based on expert judgement from workshop 1 as saline lagoons occur in sheltered areas it was thought that they should be assessed as not exposed.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(M5)	(L)	5 - Based on expert judgement by external review.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1, Saline lagoon surveys in sussex. Dependent on size of lagoon because of restriction of water exchange. Worse case scenario in small lagoon with low exchange. Elements used in assessment: biological communities

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(L4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1, Bamber 2003, English Nature reports sussex. Elements used in assessment: species communities
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(L4)	(L4)	(M4)	(L4)	(M4) (H5)	(L4)	4 - based on expert judgement from workshop 1, English Nature reports.This assessment was supported by expert review (Ian Reach, pers comm.) Elements used in assessment: species communities.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(L4)	(L4)	(H4& 10)	(L4)	4 - based on expert judgement from workshop 1, English Nature reports. Elements used in assessment: species communities 10- Expert review supported the high sensitivity, (Ian Reach, Natural England, pers comm).
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(L4)	(M4)	(M4)	(M4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: species communities
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4)	(L4)	(M4)	(M4)	(M4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: species communities
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: species communities
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: species communities
pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical p	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					(M5)	(L5)	5 - Based on expert judgement, resistance and resilience scores were not provided or supporting evidence and hence the assessment confidence is low.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Features not targeted directly
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - features of component biotopes all have medium recovery, so unlikely to be high sensitivity

2.26 Seapen and burrowing megafauna communities

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L)	1 - Feature not sensitive to this pressure benchmark
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
nshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(M3)	(L3)	(M3)	(L3)	(M3)	(L3)	3 - Based on MarLIN assessment for seapen and burrowing megafauna (for evidence see Annex H, Section 2.24)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(VL3)	(L3)	(M3)	(L3)	(M3)	(L3)	3 - Based on MarLIN assessment for seapen and burrowing megafauna (for evidence see Annex H, Section 2.24)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L)	1. Not sensitive to this pressure benchmark

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ir	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NS	(L)	1. Not sensitive to this pressure benchmark
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3)		(H3)		(NS3)	(L3)	3 - Based on MarLIN assessment for seapen and burrowing megafauna (for evidence see Annex H, Section 2.24)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(L4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - Based on expert judgement at workshop 1 supported by evidence from Pearson & Rosenberg 1978, WFD risk assessments and NCC reports on enrichment from fish cages Pereira and Black et al. 2004, the feature was judged to have a high sensitivity to organic enrichment at the pressure benchmark. Elements used in assessment: seapens and burrowing megafauna and mud substrate
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(H4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: seapens and burrowing megafauna and mud substrate
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M4)	(M4)	(H4)	(M4)	(NS3) (L4)	(M4)	3 - Based on MarLIN assessment for seapen and burrowing megafauna (for evidence see Annex H, Section 2.24) feature was judged to be not sensitive 4 - based on expert judgement from workshop 1. Elements used in assessment: seapens and burrowing megafauna and mud substrate. As the project specification was to develop an expert judgement based approach we have presented the workshop assessment in the matrix, however compared with MarLIN's evidence based approach, this may overestimate sensitivity.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: seapens and burrowing megafauna and mud substrate
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N-L7)	(L7)	(M-H7)	(H7)	(M2) (L-M7)	(L7)	2 - assessment made by MarLIN and ABPmer 7 - based on expert judgement from workshop 2; low sensitivity for nephrops, medium sensitivity for seapens. Deeper disturbance may not kill nephrops directly, but indirect effect of disturbing may lead to predation
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L-M7)	(L7)	(M-H7)	(M7)	(M2) (L-M7)	(L7)	2 - assessment made by MarLIN and ABPmer 7 - based on expert judgement from workshop 2; low sensitivity for nephrops, medium sensitivity for seapens

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(H4) (L-M7)	(M4) (L7)	(H4) (M-H7)	(L4) (M7)	(NS4) (L-M7)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: seapens and burrowing megafauna and mud substrate 7 - based on expert judgement from workshop 2; low sensitivity for nephrops, medium sensitivity for seapens. Seapen resilience, variable depending on seapens, some retract, bury, low resistance for some seapens, some mortality of species, found on the edge of the grounds, Clare Greathead, new Kaiser paper: seapens relatively long-lived
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(M2)	(L)	2 - assessment made by MarLIN and ABPmer
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - No records of significant INS impacts in this habitat
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(M4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; Males stay down at certain times of year. Current info suggests overfishing is a real danger. Poor information about stock structures for this species. Burrowing megafauna such as *Nephrops norvegicus* are targeted by a commercial fishery.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1 Seapens can be damaged by the use of fishing gears.

2.27 *Ostrea edulis* beds

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km^2 or 50% of width of water body for more than 1 year					(NS1) (NS5)	(L1)	1 - increased water flow may affect feeding rate in positive way, decreased flow may cause negative effect but not a large change 5 - Based on expert judgement from review
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(M5)	(L)	5 - Based on expert judgement by external review.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(L5)	(L)	5 - Based on expert judgement by external review.
nshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(M3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.19)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L3)		(L3)		(H3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.19) 5 - Based on expert judgement from review
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km^2 or 50% of width of water body for more than 1 year					(NS1) (NS5)	(L1)	1 - increased water flow may affect feeding rate in positive way, decreased flow may cause negative effect but not a large change 5 - Based on expert judgement by external review.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ir	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.19)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(L5)	(L)	5 - Based on expert judgement by external review.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 2.19) 5 - Based on expert judgement from review
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; don't live within sediment so anoxia in sediment shouldn't impact them too much
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(L4)	(H4)	(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(L4)	(L4)	(VL4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1; management measures usually link to reducing siltation therefore would be sensitive
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(VL4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1; high sensitivity as would be unable to feed
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(M4)	(VL4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(M4)	(VL4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; would be able to recolonise and re-settle
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(M4)	(VL4)	(M4)	(H4) (H5)	(M4)	4 - based on expert judgement from workshop 1 5 - Based on expert judgement from review
pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical p	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(H1)	(L1)	1 - Feature would be highly sensitive
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1; smothering and competition impacts depend on non-indigenous species

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Bi	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(M5)	(L1)	4 - based on expert judgement from workshop 1 5 - Based on expert judgement from review- it was felt that this assessment should be low or not sensitive where the fishery is managed sustainably (as in the pressure benchmark), based on the judgement supplied by the expert reviewer we have assessed sensitivity to this pressure as Medium- resistance and resilience scores and confidence were not supplied so, confidence is judged to be Low.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1; assume reef itself remains intact as non-targetted species are removed

2.28 Peat and clay exposures

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS5)	(L)	5 - Based on expert judgement by external review.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(H5)	(L)	5 - Based on expert judgement by external review.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(L5)	(L)	5 - Based on expert judgement by external review.
Hydrological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NA	(L)	No Assessment was supplied for this pressure x feature combination at workshops or in external review.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS5)	(L)	5 - Based on expert judgement by external review.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS5)	(L)	5 - Based on expert judgement by external review.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(L1)	(L)	1 - Feature would have low sensitivity to local changes in emergence regime

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(L1)	(L)	1 - Feature would have low sensitivity to local changes in wave exposure
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS5)	(L)	5 - Based on expert judgement by external review.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; Sewage outflow studies: Thannet and Portsmouth, Severn (Cardiff Bay work) late 1990s EIAs
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N4)	(H4)	(VL4)	(H4)	(H1) (H4)	(H4)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater 4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1; assume these environments are dynamic because of exposures, so deposited material will move away quickly
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - based on expert judgement from workshop 1; assume these environments are dynamic because of exposures, so deposited material will move away quickly
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(M4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - based on expert judgement from workshop 1; Pipeline Lymington - Yarmouth EIA
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(H4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(H4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(M4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - based on expert judgement from workshop 1; assume what is left is still peat and clay - not looking to re-accrete the 30cm removed
er physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Oth	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - No INS recorded as having impacts on these habitats
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - Unlikely that significant component of feature would be removed on single pass. Remaining feature could be recolonized. Could be at risk from repeated trawl damage leading to eventual loss of feature

2.29 *Sabellaria alveolata* reefs

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS5)	(L)	5 - Based on expert judgement by external review
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(M10)	(L)	10 - Updated based on the assessment of water flow for hydrological changes.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(H5)	(L)	5 - Based on expert judgement by external review.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(M3) (N4)	(M4)	(H3) (VL4)	(M4)	(L3) (H4)	(M4)	3 - Refer to Marlin evidence (see Annex H, Section 2.21) 4 - based on expert judgement from workshop 1; Gruet 1982, Bamber and Irving 1997. In the matrix the discrepancy between assessments was resolved by assessing features as High. This was based on the collated evidence presented with Holt et al. 1998 . Further evidence supporting this assessment was based on reefs around the Wirral foreshore & Hilbre Island winters 2009 & 2010 (Ian Reach pers.obs.).

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(M3) (H4)	(L4)	(H3) (H4)	(L4)	(L3) (NS4) (NS5) (NS10)	(L3) (L4)	3 - Refer to Marlin evidence (see Annex H, Section 2.21) 4 - based on expert judgement from workshop 1; Holt 1998 5 - Based on expert judgement by external review. The assessment of not sensitive was supported by an expert reviewer, in consideration of the benchmark, the assessment of 'not sensitive' was presented in the sensitivity matrix (Ian Reach, pers. comm.).
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H3) (L4)	(L4)	(H3) (L4)	(L4)	(NS3) (H4) (M10)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 2.21) 4 - Based on expert judgement from workshop 1. This assessment was reviewed and although it was accepted that the feature is sensitive to changes in tidal current - which may be a cause of reef degradation / loss & also evolution when linked to sediment transport,given the medium benchmark then an assessment of H was too precautionary and that a Medium sensitivity would be used (Ian Reach pers obs reefs at Wirral & Hilbre Island). This assessment was updated in the matrix to resolve the differing assessments.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(M3) (M4)	(L4)	(H3) (M4)	(L4)	(L3) (M4)	(L3) (L4)	3 - Refer to Marlin evidence (see Annex H, Section 2.21) 4 - based on expert judgement from workshop 1
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(L3) (L4)	(L4)	(M3) (L4)	(L4)	(M3) (H4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 2.21) 4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3) (H4)	(L4)	(H3) (H4)	(L4)	(NS3) (NS4) (M5)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 2.21) 4 - based on expert judgement from workshop 1 5 - Based on expert judgement by external review. AN expert reviewer did not support an assessment of NS as this does not account for reduction in turbidity i.e. an increase in water clarity which is a scenario possible under M benchmark,therefore they suggested that the sensitivity should be medium/high. However as clarity was felt to refer to light penetration rather than suspended sediment, the assessment presented in the matrix is 'Not Sensitive'.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N4)	(L4)	(L4)	(L4)	(H1) (H4)	(L4)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater 4 - based on expert judgement from workshop 1
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M3) (H4)	(L4)	(H3) (H4)	(L4)	(L3) (NS4)	(M3) (L4)	3 - Refer to Marlin evidence (see Annex H, Section 2.21) 4 - Based on expert judgement from workshop 1. The assessment was reviewed by an expert wjo judged that the reefs are NS for similar reasons to Sabellaria spinulosa although empirical data was not available to support this judgement. The judgement is therefore based on known locations of reefs and SSC in waters supporting them and the natural variability of the SSC mean that deposition is likely. A judgement of Not Sensitive was presented in the matrix.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(M4)	(L4)	(H4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop 1
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(M4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(M4)	(L4)	(L4)	(H1) (H4)	(L4)	4 - based on expert judgement from workshop 1
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(H4)	(H4)	(M4)	(H4)	(L4)	(H4)	4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(L4)	(L4)	(L4)	(H4) (H5)	(L4)	4 - based on expert judgement from workshop 1 5 - Based on expert judgement by external review
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - no INS identified that might occur in such dynamic environments
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted directly; removal of other target speciesu nlikely to affect reefs
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(N1)	(H1)	(L1)	(M1)	(H1)	(M1)	1 - Good evidence of physical damage to reefs and on rates of recovery

2.30 *Sabellaria spinulosa* reefs

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(L10)	(L)	1 - See water flow assessment for hydrological changes pressure theme.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H3)		(H3)		(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.22)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(M3)		(H3)		(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.22)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1) (L10)	(L1)	10 - It was initially judged that the feature was 'Not Sensitive' to this pressure benchmark. however an expert reviewer identified that MALSF research was currently looking at bedloads associated with marine aggregate extraction and reef evolution. Preliminary results may indicate that bedloads associated with water flow changes at a local scale may affect reef building due to sediment transport and availability. The work will report end FY 2010/11 and it was considered appropriate to provide a precaustionary assessment of Low sensitivity to this feature. The low confidence assigned to this assessment reflects this uncertainty and resistance and resilience assessments were not provided.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS1)	(L1)	1 - Not Sensitive to this pressure benchmark
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3) (H4)	(L4)	(H3) (H4)	(L4)	(NS3) (NS4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 2.22) 4 - based on expert judgement from workshop 1
...ges	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical chan[ges]	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(H4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N4)	(H4)	(L4)	(L4)	(H1) (H4)	(L4)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater 4 - based on expert judgement from workshop 1
[...]age	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M3) (H4)	(M4)	(H3) (H4)	(M4)	(L3) (NS4)	(M4)	3 - Refer to Marlin evidence (see Annex H, Section 2.22) 4 - based on expert judgement from workshop 1; Davies et al 2009. These assessments were reviewed by an expert who supported the NS assessment (in matrix) on the basis of 2 MALSF projects providing information on this: (research into sediment smothering survivability (Kim Last) and the Area 447 Sabellaria spinulosa distribution and evolution report).
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(M4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical dam	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - based on expert judgement from workshop 1; Jones 1999, Reise 1982, Reise and Shubert 1987, Riesen and Reise 1982
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(VL4)	(L)	(L4)	(L)	(H4)	(L)	4 - based on expert judgement from workshop 1. Confidence assessments were not provided at the workshop and hence we have been precautionary and assigned low confidence to this assessment.
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - No INS identified that might persist in such dynamic environments
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted directly; removal of other target species unlikely to affect reefs
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; Reise 1987, Reise and Shubert 1987

2.31 Seagrass beds

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s	(M7)	(M7)	(VL7)	(M7)	(M7)	(M7)	7 - based on expert judgement from workshop 2; scientific papers on reproduction of seagrass beds. Assume cannot remove pressure of climate change so recovery is VL. Elements used in assessment: intertidal seagrass beds
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100	(M7)	(M7)	(VL7)	(M7)	(M7)	(M7)	7 - based on expert judgement from workshop 2; scientific papers on reproduction of seagrass beds. Seagrass beds not tolerant to temperature change. Elements used in assessment: intertidal seagrass beds
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H4) (M7)	(H4) (L7)	(H4) (M7)	(H4) (L7)	(NS4) (NS5) (M7)	(H4) (H7)	4 - based on expert judgement from workshop 1 5 - Based on expert judgement by external review. 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London	(N7)	(M7)	(VL7)	(M7)	(H5) (H7)	(M7)	5 - Based on expert judgement by external review. 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(M7)	(L7)	(VL7)	(L7)	(M5) (M7)	(L7)	5 - Based on expert judgement by external review. 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; Bull et al. 2010.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(H3) (H4) (H7)	(M4) (M7)	(H3) (H4) (H7)	(M4) (M7)	(NS3) (NS4) (NS5) (NS7)	(M4) (M7)	3 - Refer to Marlin evidence (see Annex H, Section 2.23) 4 - based on expert judgement from workshop 1; Den Hartog 1970; 1977 5 - Based on expert judgement by external review. 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H4) (M7)	(H4) (L7)	(H4) (M7)	(H4) (L7)	(NS4) (NS5) (M7)	(H4) (H7)	4 - based on expert judgement from workshop 1 5 - Based on expert judgement by external review. 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(M3) (M4) (M7)	(M4) (L7)	(L3) (H4) (M7)	(M4) (L7)	(M3) (L4) (M7)	(M4) (M7)	3 - Refer to Marlin evidence (see Annex H, Section 2.23) 4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(M7)	(L7)	(VL7)	(L7)	(M5) (M7)	(L7)	5 - Based on expert judgement from review 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(VL3) (L4) (M7)	(M4) (L7)	(VL3) (H4) (M7)	(M4) (L7)	(H3) (L4) (M7)	(M4) (L7)	3 - Refer to Marlin evidence (see Annex H, Section 2.23) 4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical changes	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status	(M7)	(M7)	(M7)	(M7)	(M7)	(M7)	7 - based on expert judgement from workshop 2; eutrophication damages eelgrass plants, sensitivity depends on level
	Organic enrichment	100gC/m²/yr	(H4) (M7)	(M4) (M7)	(H4) (M7)	(M4) (M7)	(NS4) (M7)	(M4) (M7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2; Ref papers on eutrophication damaging eelgrass plants. Elements used in assessment: intertidal and subtidal seagrass beds
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(L4) (L7)	(L4) (L7)	(M4) (M7)	(L4) (L7)	(M4) (M7)	(L4) (L7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N7)	(H7)	(VL7)	(H7)	(H1) (H7)	(H7)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(VL3) (M4) (M7)	(L4) (L7)	(VL3) (H4) (M7)	(L4) (L7)	(H3) (L4) (M7)	(L4) (L7)	3 - Refer to Marlin evidence (see Annex H, Section 2.23) 4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal seagrass beds

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4) (N7)	(L4) (L7)	(M4) (L7)	(L4) (L7)	(M4) (H7)	(L4) (L7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal seagrass beds
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4) (N7)	(M4) (H7)	(L4) (VL7)	(L4) (H7)	(H4) (H7)	(L4) (H7)	4 - based on expert judgement from workshop 1; Domacini et al 2002 7 - based on expert judgement from workshop 2. 7 - based on expert judgement from workshop 2. Elements used in
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N7)	(H7)	(L7)	(H7)	(H1) (H7)	(H7)	7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L4) (M7)	(M4) (M7)	(H4) (M7)	(L4) (M7)	(L4) (M7)	(L4) (M7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4) (N7)	(H4) (H7)	(L4) (VL7)	(L4) (H7)	(H4) (H5) (H7)	(L4) (H7)	4 - based on expert judgement from workshop 1 5 - Supported by expert judgement in review 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
er physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Oth	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L4) (M7)	(M4) (L7)	(VL4) (M7)	(M4) (L7)	(M1) (H4) (M5) (M7)	(L1) (M4) (L7)	1 - most likely INS threat will be macroalgae but unlikely to dominate assemblage set as S=M 4 - based on expert judgement from workshop 1 5 - Based on expert judgement by external review. 7 - based on expert judgement from workshop 2. Elements used in assessment: intertidal and subtidal seagrass beds
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(H1)	(H1)	(H1)	(NS1)	(H1)	1 - biotope features not targted directly
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L7)	(H7)	(L7)	(H7)	(H7)	(H7)	7 - based on expert judgement from workshop 2; targetting of clams issue in Solent. Elements used in assessment: intertidal and subtidal seagrass beds

2.32 Seamounts

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1. Not Assessed. New evidence has just been published that seamounts will act as important refugia for deep-water calcified organisms as the ocean acidify (Tiitensor et al., in press)
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H8)	(L)	8 - based on expert judgement from workshop 3
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
re/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L8)	(L8)	(L8)	(L8)	(H8)	(L8)	8 - based on expert judgement from workshop 3
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L8)	(L8)	(L8)	(L8)	(H8)	(L8)	8 - based on expert judgement from workshop 3
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L8)	(L8)	(L8)	(L8)	(H8)	(L8)	8 - based on expert judgement from workshop 3

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshor	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H8)	(L8)	(H8)	(L8)	(NS8)	(L8)	8 - based on expert judgement from workshop 3
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 Not Sensitivie
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N8)	(H8)	(N8)	(H8)	(H8)	(H8)	8 - based on expert judgement from workshop 3
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(N8)	(L8)	(VL8)	(H8)	(H8)	(M8)	8 - based on expert judgement from workshop 3
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N8)	(L8)	(VL8)	(H8)	(H8)	(M8)	8 - based on expert judgement from workshop 3
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N8)	(L8)	(VL8)	(H8)	(H8)	(M8)	8 - based on expert judgement from workshop 3
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N8)	(H8)	(VL8)	(H8)	(H8)	(M8)	8 - based on expert judgement from workshop 3
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(N8)	(H8)	(VL8)	(H8)	(H8)	(M8)	8 - based on expert judgement from workshop 3
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N8)	(H8)	(VL8)	(H8)	(H8)	(M8)	8 - based on expert judgement from workshop 3
pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical p	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NS	(L1)	1. Feature judged to be not sensitive as it is not a target species commercially expoited.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(H1)	(H1)	1 - Based on the assessments made for abrasion-pressures, the feature is assessed to be highly sensitive to incidental damage by towed gears.

2.33 Serpulid reefs

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H1)	(L1)	1 - Feature would be highly sensitive to tide and ocean current changes
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NA	(L)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
(inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H3)		(H3)		(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.7)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(VL3)		(VL3)		(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.7)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(VL3)		(VL3)		(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.7)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(NE3)		(NE3)		(NE3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.7)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(NE3)		(NE3)		(NE3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.7)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3)		(H3)		(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 2.7)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NA	(L1)	No Assessment was supplied for this pressure x feature combination at workshops or in external review.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H1)	(L1)	1 - Feature would be highly sensitive to a change in seabed type
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M3) (M4)	(M4)	(M3) (H4)	(M4)	(M3) (L4)	(L3) (M4)	3 - Refer to Marlin evidence; Medium rersistance to represent loss of component species and interference with Serpulid recruitment 4 - based on expert judgement from workshop 1. As the project specification was to develop an expert judgement based approach we have presented the workshop assessment in the matrix, however compared with MarLIN's evidence based approach, this may underestimate sensitivity.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; Chapman et al 2007
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; Chapman et al 2007
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(M4)	(VL4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; Chapman et al 2007
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; Chapman et al 2007, work of Colin Moore e.g. Moore 1996, Moore et al 1998
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(M4)	(VL4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; Chapman et al 2007, Moore et al 2009, Hughes et al 2008. Assume loch populations will be isolated therefore will not recover.
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Several INS may potentially affect this habitat
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(NE4)		(NE4)		(NE4)	(L)	4 - based on expert judgement from workshop 1
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - feature is at risk of removal as by-catch

2.34 Shallow tideswept coarse sands with burrowing bivalves

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(NE1)	(L1)	1 - Feature occurs subtidally and is judged to be not exposed to atmospheric climate change.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - Feautres unlikely to be especially sensitive to temperature in mid-range
	Salinity changes - regional/national	0.2 psu decrease by 2100					(NS1)	(L1)	1 - The feature was judged to be 'not sensitive' to this pressure benchmark as the feature occurs both at the open coast and in estuaries where salinity is variable.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - The feature occurs in areas wwhere tidal streams vary from moderately strong to weak (JNCC on-line biotope descriptions). The feature was therefore judged to be 'not sensitive' to changes in wave exposure at the pressures benchmark.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(NS1)	(L1)	1 - This feature occurs subtidally and is not judged, therefroe, to be sensitive to changes in emeregence regime.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS1)	(L1)	1 - The feature occurs in areas with wave exposure varying from sheltered to exposed (JNCC on-line biotope descriptions). The feature was therefore judged to be 'not sensitive' to changes in wave exposure at the pressures benchmark.
re/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - Feautres unlikely to be especially sensitive to temperature in mid-range
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - could be influenced by reduced slainities but would be expected to recover rapidly
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - The feature occurs in areas wwhere tidal streams vary from moderately strong to weak (JNCC on-line biotope descriptions). The feature was therefore judged to be 'not sensitive' to changes in wave exposure at the pressures benchmark.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshor	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(NS1)	(L1)	1 - This feature occurs subtidally and is not judged, therefore, to be sensitive to changes in emeregence regime.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS1)	(L1)	1 - The feature occurs in areas with wave exposure varying from sheltered to exposed (JNCC on-line biotope descriptions). The feature was therefore judged to be 'not sensitive' to changes in wave exposure at the pressures benchmark.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H1)	(M1)	(H1)	(M1)	(NS1)	(M1)	1 - Moderate diversity communities in stable sand communities are judged to have low sensitivity to high levels of suspended sediment, for examples see JNCC/NE 2009.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - Based on expert judgement at workshop 1. Elements used in assessment: burrowing bivalves, substrate gravelly sand, high energy
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Changes to substrate type would lead to reclassification of this habitat type, recovery following return to conditions was judged to take place within 2-10 years
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - Based on expert judgement at workshop 1 and informed by evidence from MarLIN (see Annex H 2.25). Bivalves and other benthic infauna are generally able to escape from burial of more than 10cm. Bivalves are able to clear gills so would be expected to reposition in sediment and avoid gill clogging (Grant & Thorpe 1991). Cockles buried under 5cm of sediment have been able to re-estasblish siphon contact with surfasce in less than 24 hours (Chang & Levings 1978). Elements used in assessment: burrowing bivalves, substrate gravelly sand, high energy
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(M4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - Based on expert judgement at workshop 1. As the environment was judged to be energetic, deposited sediment would be removed by water action ameliorating effects. Sensitivity to physical damage pressures informed by work on Bassurelle sandbank by JNCC (JNCC 2008). Elements used in assessment: burrowing bivalves, substrate gravelly sand, high energy
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - Based on expert judgement at workshop 1. Sensitivity to physical damage pressures informed by work on Bassurelle sandbank by JNCC (JNCC 2008). Elements used in assessment: burrowing bivalves, substrate gravelly

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - Based on expert judgement at workshop 1. Sensitivity to physical damage pressures informed by work on Bassurelle sandbank by JNCC (JNCC 2008). Elements used in assessment: burrowing bivalves, substrate gravelly sand, high energy
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(M4)	(H4)	(M4)	(L4)	(M4)	4 - Based on expert judgement at workshop 1. Sensitivity to physical damage pressures informed by work on Bassurelle sandbank by JNCC (JNCC 2008). Elements used in assessment: burrowing bivalves, substrate gravelly sand, high energy
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(M4)	(H4)	(M4)	(M4)	(M4)	4 - Based on expert judgement at workshop 1. Sensitivity to physical damage pressures informed by work on Bassurelle sandbank by JNCC (JNCC 2008). Recruitment judged to be relatively rapid in high energy environments. Elements used in assessment: burrowing bivalves, substrate gravelly sand, high energy
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - Venerid bivalves not subject to a commercial fishery. Elements used in assessment: burrowing bivalves, substrate gravelly sand, high energy
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M4)	(L4)	(H4)	(M4)	(L4)	(L4)	4 - some risk of removal through by-catch but recovery likely to be high. Elements used in assessment: burrowing bivalves, substrate gravelly sand, high energy

2.35 Sheltered muddy gravels

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS5)	(L)	5 - Based on expert judgement by external review.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(NS1)	(L)	1 - This feature occuris in the intertidal and shallow subtidal (BRIG 2008) and is therefore not predicted to be sensitivie to emeregence changes at the pressure benchmark.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M5)	(L)	5 - Based on expert judgement by external review.
...nges (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS5)	(L)	5 - Based on expert judgement from CCW. This habitat is found over a salinity gradient from fully marine to estuarine (BRIG 2008), salinity influences the composition of the biological assemblage present but changes in salinity would not be expected to remove or alter the feature so that it was unrecognisable.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS5)	(L)	5 - Based on expert judgement by external review.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological cha	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(NS1)	(L1)	1 - This feature occuris in the intertidal and shallow subtidal (BRIG 2008) and is therefore not predicted to be sensitivie to emeregence changes at the pressure benchmark.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(M5)	(L)	5 - Based on expert judgement by external review.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(M5)	(L)	5 - Based on expert judgement by external review.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; fish farming studies. Assessment based on burrowing infauna (anemones, polychaetes, bivalves, etc), epifauna (ascidians, sponges, seapens), energy conditions and substrate
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Sedimentary compositin is a characterising element of this feature and contributes to high diversity within the biological assemblage the feature was therefore judged to have no resistance to physical change with recovery following return to conditions taking between 2-10 years.
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(L4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; low energy environment so sediment would stay for longer than in subtidal sands and gravels. Assessment based on burrowing infauna (anemones, polychaetes, bivalves, etc), epifauna (ascidians, sponges, seapens), energy conditions and substrate
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(M4)	V(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1. Assessment based on burrowing infauna (anemones, polychaetes, bivalves, etc), epifauna (ascidians, sponges, seapens), energy conditions and substrate
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; for littoral habitats resistance could be low but = same score overall. Assessment based on burrowing infauna (anemones, polychaetes, bivalves, etc), epifauna (ascidians, sponges,
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(M4)	(M4)	(M4)	(M4) (H5)	(M4)	4 - based on expert judgement from workshop 1; for littoral habitats resistance could be low but = same score overall. Assessment based on burrowing infauna (anemones, polychaetes, bivalves, etc), epifauna (ascidians, sponges, seapens), energy conditions and substrate 5 - Based on expert judgement by external review.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; for littoral habitats resistance could be low but = same score overall. Assessment based on burrowing infauna (anemones, polychaetes, bivalves, etc), epifauna (ascidians, sponges, seapens), energy conditions and substrate
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(M4)	(L4)	(L4)	(H4) (H5)	(L4)	4 - based on expert judgement from workshop 1. Assessment based on burrowing infauna (anemones, polychaetes, bivalves, etc), epifauna (ascidians, sponges, seapens), energy conditions and substrate 5 - Based on expert judgement by external review.
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					(NS1)	(L1)	1 - Oysters are not listed as a characterising element of this feature, so the feature is not predicted to be sensitive to microbial pathogens .
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-H1)	(L1)	(M1)	(M1)	(M1) (M5)	(L1)	1 - coarser substrates may be susceptible to INS but muddier habitats may be resistant. One constituent biotope (SS.SMx.IMx.CreAsAn) contains INS (Crepidula fornicata). Crepidula fornicata can dominate the fauna resulting in the smothering of the sediment surface leading to anoxia in the sediment (BRIG 2008). 5 - Based on expert judgement by external review.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L-H1)	(M1)	M-H1	(M1)	(L-M1)	(M1)	1 - Resistance low to removal of e.g. Cerastoderma but likely to be high for removal of other possible target species (e.g. scallop)
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L-M1)	(M1)	(M1)	(M1)	(M1)	(M1)	1 - commercial harvesting methods likely to remove non-target species in significant quantities. Evidence from e.g. cockle fisheries, scallop dredging

2.36 Submarine structures made by leaking gases

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
nd other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution ar	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS1	(L1)	1 - This assessment was based on the carbonate reef assessment (Annex G 2.3) as these features were judged to be equivalent/similar.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					No evid.	(L)	1 - This assessment was based on the carbonate reef assessment (Annex G 2.3) as these features were judged to be equivalent/similar.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N1)	(H1)	(VL1)	(H1)	(H1)	(H1)	1 - Features are judged to have high sensitivity to the loss of the feature.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - This assessment was based on the carbonate reef assessment (Annex G 2.3) as these features were judged to be equivalent/similar.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					No evid.	(L)	
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth						(L)	
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm						(L)	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features						(L)	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm						(L)	
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					f	(L1)	1 - This assessment was based on the carbonate reef assessment (Annex G 2.3) as these features were judged to be equivalent/similar.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(NS1)	(L1)	
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(M1)	(L1)	

2.37 Subtidal chalk

Pressure theme	Pressure	Benchmark	Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(M1)	(H1)	(M1)	(NS1)	(M1)	1 - Minor changes in flow regime would not be expected to modify these biotopes (which are mostly characterized by substrate type)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H1)	(M1)	(H1)	(M1)	(NS1)	(M1)	1 - Minor changes in wave exposure would not be expected to modify these biotopes
Hydrological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(H1)	(M1)	(H1)	(M1)	(NS1)	(M1)	1 - Most marine organisms can tolerate minor increases in salinity; marine biotopes unlikely to be epxosed to substantially lowere salinities
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(M1)	(H1)	(M1)	(NS1)	(M1)	1 - Minor changes in flow regime would not be expected to modify these biotopes (which are mostly characterized by substrate type)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hy	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H1)	(M1)	(H1)	(M1)	(NS1)	(M1)	1 - Minor changes in wave exposure would not be expected to modify these biotopes
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(L-H1)	(M1)	(M-H1)	(M1)	(NS-M1)	(M1)	1 - Unlikely to affect faunal assemblages; could affect biotopes with algae (e.g. IR.MIT.KR.HiaSw)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	>
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(M4)	(L4)	(H4)	(M4)	(L4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: presence of chalk, burrowing infauna, epifauna (algal)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: presence of chalk, burrowing infauna, epifauna (algal)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: presence of chalk, burrowing infauna, epifauna (algal)
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M4)	(H4)	(H4)	(H4)	(L4)	(H4)	4 - based on expert judgement from workshop 1; Assume environments are dynamic to some extent because of

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; Assume environments are dynamic to some extent because of exposures so deposited material will move away quickly. Worst case scenario. Elements used in assessment: presence of chalk, burrowing infauna, epifa
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: presence of chalk, burrowing infauna, epifauna (algal)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4)	(L4)	(H4)	(M4)	(L4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: presence of chalk, burrowing infauna, epifauna (algal)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(L4)	(H4)	(M4)	(L4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: presence of chalk, burrowing infauna, epifauna (algal)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(L4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: presence of chalk, burrowing infauna, epifauna (algal)
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-H1)	(L1)	(M-H1)	(L1)	(M1)	(L1)	1 - IR.MIR.KR.HiaSw may support INS such as macroalgae; other comonent biotopes unlikely to support known INS
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)		(H1)		(NS1)	(M1)	1 - features not targeted directly
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M4)	(M4)	(H4)	(H4)	(L4)	(M1)	4 - based on expert judgement from workshop 1. Elements used in assessment: presence of chalk, burrowing infauna, epifauna (algal)

2.38 Subtidal mixed muddy sediments

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(M-H1)	(L1)	(H1)	(L1)	(NS-L1)	(L1)	1 - Minor flow changes could influence sediment composition
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Feature is subtidal and therefore judged to be not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(M-H1)	(L1)	(H1)	(L1)	(NS-L1)	(L1)	1 - Minor changes in wave energy could influence sediment composition
(inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(M-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1 - Some species features could be sensitive to temperature change but would be expected to recover
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L-H1)	(L1)	(L-H1)	(L1)	(NS-H1)	(L1)	1 - Estuarine features could be significantly affected by reduced salinitieis and some may be slow to recover e.g. Ostrea; marine biotopes unlikely to be affected by increased or lowered salinities
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(M-H1)	(L1)	(H1)	(L1)	(NS-L1)	(L1)	1 - Minor flow changes could influence sediment composition

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Feature is subtidal and therefore judged to be not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(M-H1)	(L1)	(H1)	(L1)	(NS-L1)	(L1)	1 - Minor changes in wave energy could influence sediment composition
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(M-H1)	(L1)	(H1)	(L1)	(NS-L1)	(L1)	1 - Changes in water clarity would influence infralittoral biotopes with algal component, although algal component associated with these biotopes tends not to be significant
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H1)	(L1)	1 - Feature would be highly sensitive to a change in seabed type
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - The feature comprises mixed sediments including mud and it is judged to therefore host a biological assemblage
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - While this feature is judged to be not sensitive to low siltation events that addition of 30cm of sediment would constitute a large change in habitat conditions which would be predicted to lead to substantial mortality of epifaunal and infaunal species. The resistance to such an event was judged to be low and recovery following sediment removal to take between 2-10 years.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(H1)	(L1)	1 - Feature would be highly sensitive to disturbance
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(H1)	(L1)	1 - Feature would be highly sensitive to heavy abrasion
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(M1)	(L1)	1 - Fishing effects on epifauna and infauna, tubiculous polychaetes, sessile fragile bivalves
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(H5)	(L)	5 - Based on expert judgement by external review.
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-H1)	(L1)	(M1)	(M1)	(L-M1)	(L1)	1 - coarser substrates may be susceptible to INS but muddier habitats may be resistant

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(M-H1)	(M1)	(H1)	(M1)	(L1)	(M1)	1 - Target species could include scallop, but recovery likely to be high; evidence fro assessment of scallop fisheries
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L-M1)	(M1)	(M1)	(M1)	(M1)	(M1)	1 - commercial harvesting methods may remove non-target species in significant quantities. Evidence from e.g. scallop dredging

2.39 Subtidal sands and gravels

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Component habitats unlikely to be especially sensitive to temperature change in mid-range
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(M1)	(H1)	(M1)	(NS1)	(M1)	1 - Minor changes in flow unlikely to substantially alter sediment composition
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H7)	(H7)	(H7)	(H7)	(NS7)	(H7)	7 - based on assessment from workshop 2
ore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Component habitats unlikely to be especially sensitive to temperature change in mid-range; Hayward et al
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(M-H7)	(L7)	(M-H7)	(L7)	(L7)	(L7)	7 - based on assessment from workshop 2
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(M1)	(H1)	(M1)	(NS1)	(M1)	1 - Minor changes in flow unlikely to substantially alter sediment composition

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (insh	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H7)	(H7)	(H7)	(H7)	(NS7)	(H7)	7 - based on assessment from workshop 2
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H7)		(H7)	(H7)	(NS7)	(H7)	7 - based on assessment from workshop 2, supported by evidence and judgements made for other sand and gravel habitats (see Annex G, Section 2.39)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1; Kenny 1992, Cogan 2010 - comparison to Holme data, KES late 90s. Elements used in assessment: substrate (characteristic particle size distributions), colonial sessile epifauna, infaunal polychaetes
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(M7)	(H7)	(M-H7)	(H7)	(L-M7)	(H7)	7 - based on assessment from workshop 2.Although a sensitivty range was developed in the workshop the most precautionary assessment was used in the matrix.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M4) (N H7)	(H4)	(H4) (M-H7)	(H4) (M7)	(L4) (NS- M7)	(H4) (M7)	4 - based on expert judgement from workshop 1; assessment made on average habitat. Elements used in assessment: substrate (characteristic particle size distributions), colonial sessile epifauna, infaunal polychaetes 7 - based on assessment from workshop 2. Expert review indicated that the sensitivity for this feature was best represented as a range as this is such a broad habitat sensitivity to pressures can vary from Low (for highly mobile sediments) to High (for stable sands and long-lived bivalve communities). A range was therefore useed in the matrix.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L4) (N- H7)	(H4)	(M4) (M-H7)	(H4) (M7)	(M4) (NS- M7)	(H4) (M7)	4 - based on expert judgement from workshop 1. Elements used in assessment: substrate (characteristic particle size distributions), colonial sessile epifauna, infaunal polychaetes 7 - based on assessment from workshop 2. Expert review indicated that the sensitivity for this feature was best represented as a range as this is such a broad habitat sensitivity to pressures can vary from Low (for highly mobile sediments) to High (for stable sands and long-lived bivalve communities). A range was therefore useed in the matrix.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4) (L-M7)	(H4) (M7)	(M4) (H7)	(H4) (M7)	(M4) (L7)	(H4) (M7)	4 - based on expert judgement from workshop 1; Firth of Lorn studies. AElements used in assessment: substrate (characteristic particle size distributions), colonial sessile epifauna, infaunal polychaetes 7 - based on assessment from workshop 2
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4) (L-H7)	(H4)	(M4) (M7)	(H4) (H7)	(M4) (L-M7)	(H4) (H7)	4 - based on expert judgement from workshop 1; assessment made on average habitat - based on knowlede of full range of conditions rather than worst case scenario. Elements used in assessment: substrate (characteristic particle size distributions), colonial sessile epifauna, infaunal polychaetes 7 - based on assessment from workshop 2
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4) (L-H7)	(H4) (M-H7)	(M4) (L-H7)	(H4) (M-H)	(M4) (NS-H7)	(H4) (M7)	4 - based on expert judgement from workshop 1. Elements used in assessment: substrate (characteristic particle size distributions), colonial sessile epifauna, infaunal polychaetes 7 - based on assessment from workshop 2. Expert review indicated that the sensitivity for this feature was best represented as a range as this is such a broad habitat sensitivity to pressures can vary from Low (for highly mobile sediments) to High (for stable sands and long-lived bivalve communities). A range was therefore useed in the matrix.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4) (N7)	(H4) (H7)	(M4) (M-H7)	(H4) (H7)	(M4) (L7)	(H4) (H7)	4 - based on expert judgement from workshop 1; Kenny, Boyd - Cefas studies, ALSF, ICES reports. Elements used in assessment: substrate (characteristic particle size distributions), colonial sessile epifauna, infaunal polychaetes 7 - based on assessment from workshop 2. Expert review indicated that the sensitivity for this feature was best represented as a range as this is such a broad habitat sensitivity to pressures can vary from Low (for highly mobile sediments) to High (for stable sands and long-lived bivalve communities). A range was therefore useed in the matrix.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1. Feature not characterised by Ostrea edulis and hence not sensitive to the pressure benchmark.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L-H7)	(L7)	(M-H7)	(M7)	(NS-M7)	(L7)	7 - based on assessment from workshop 2; more stable substrates may be susceptible to INS but less stable habitats may be resistant. Crepidula outcompete modiolus
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L-H1) (N7)	(L7)	(M-H1) (M-H7)	(M-H7)	(NS-M1) (M7)	(L7)	7 - based on assessment from workshop 2; 1 - sensitivity depends on biotope. Some biotopes include targeted features e.g. cockles; scalops) and biotopes will be directly affected. Other biotopes will be largely unaffected.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L-H1) (M4) (M-H7)	(L4) (M7)	(M-H1) (H4) (M-H7)	(L4) (M7)	(NS-M1) (L4) (NS-M7)	(L4) (M7)	1 - commercial harvesting methods may remove non-target species in significant quantities. Evidence from e.g. Cockle and scallop dredging 4 - based on expert judgement from workshop 1; risk of causing damage much less because we have done an appropriate assessment. Elements used in assessment: substrate (characteristic particle size distributions), colonial sessile epifauna, infaunal polychaetes 7 - based on assessment from workshop 2

2.40 Tideswept algal communities

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L4)	(M4)	(H4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop 1; Connor et al 1997. Elements used in assessment: kelp
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(L4)	(L4)	(H4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: kelp
s (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(M4)	(H4)	(H4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop 1; Bartsch et al 2008, Bremen? 1980s, Brody et al 2009. May differ with location around UK - have restricted temperature ranges so in southern areas may reach threshold. Elements used in assessment: kelp
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L4)	(L4)	(H4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: kelp
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L4)	(M4)	(H4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop 1; Connor et al 1997. Elements used in assessment: kelp

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(L4)	(L4)	(H4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop 1; different communities at different shore levels so difficult to assess. Elements used in assessment: kelp
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(L4)	(L4)	(H4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: kelp
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H4)	(H4)	(M4)	(H4)	(L4)	(H4)	4 - based on expert judgement from workshop 1; Kain 1985?, Dayton1985. Elements used in assessment: kelp
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(M4)	(L4)	(L4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; Knight 1970s.Assessment made in regards to input of raw sewage - but very site specific. Going to be flushed out quickly - difficult to consider effect of organic enrichment solely on its own. Elements used in assessment: kelp
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(L1)	(L1)	1 - Feature is unlikely to be sensitive to a change in seabed type
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H4)	(H4)	(H4)	(H4)	NS	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: structure and function of habitat and
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(H4)	(H4)	(H4)	(H4)	NS	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: structure and function of habitat and communities
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(H4)	(M4)	(H4)	(M4)	(H4)	4 - based on expert judgement from workshop 1; Tittley 1970, Lodge, Burrows, Parks, Lewis 1964. Elements used in assessment: structure and function of habitat and communities
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4)	(H4)	(M4)	(H4)	(M4) (L5)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: structure and function of habitat and communities 5 -Expert review suggested that recovery may be quicker, within a year, and that sensitivity would be lower. In the matrix we have presented the more precautionary assessment supported at the workshop (which was assigned a high confidence by experts) but recognise that there is uncertainty around this assessment.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(H4)	(H4)	(H4)	(L4)	(H4)	4 - based on expert judgement from workshop 1. Trampling and recreational diving a problem. Elements used in assessment: structure and function of habitat and communities
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(M4)	(H4)	(M4)	(H4)	4 - based on expert judgement from workshop 1; Tittley 1970, Lewis 1964. Elements used in assessment: structure and function of habitat and communities

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(H1)	(M1)	(H1)	(M1)	(H1)	1 - Species such as Sargassum and Undaria can be very invasive, dominating algal canopy
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(M4)	(H4)	(H4)	(H4)	(L4)	(H4)	4 - based on expert judgement from workshop 1. In Scotland removal of species from shore is licenced, some regulation, but different between different parts of UK. Harvesting is licenced through TCE, but benchmark indicates conservation regulations are taken account of. Concluded that this ahbitat was not a suitable place for harvesting due to being tide swept. Elements used in assessment: kelp and epibiota
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M4)	(L4)	(M-H1) (H4)	(H4)	(L-M1) (L4)	(L4)	1 - recovery of kelp holdfast assemblages could be relatively slow 4 - based on expert judgement from workshop 1. Lobster creeling, impact may vary between sites. Elements used in assessment: kelp

2.41 Tideswept channels

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - According to the UK BAP habitat description (BRIG 2008) this feature occurs in areas of strong water movement, an increase in water flow at the pressure benchmark was not judged to represent a change from prevailing conditions and the feature was judged to be 'not sensitive'.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(NS1)	(L1)	1 - This feature is subtidal and was judged to be not sensitive to increases in ASL at the pressures benchmark.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS1)	(L1)	1 -Tidal streams are apparent down to 30m, given the strength of these and the adaptation of the community to these prevailing conditions this feature was judged to be 'not sensitive' to changes in wave exposure at the pressure benhcmark.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NA	(L1)	No Assessment was supplied for this pressure x feature combination at workshops or in external review.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS1)	(L1)	1 -Tide swept channels occur at the mouth of enclosed water bodies including sea lochs and drowned river valleys (rias) these locations experience variations in salinity which influence community composition (BRIG 2008), although community composition can vary the geology and hydrodynamics which are the most obvious characterising elements are not altered. hence this feature was judged to be not sensitive to changes in salinity.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - According to the UK BAP habitat description (BRIG 2008) this feature occurs in areas of strong water movement, an increase in water flow at the pressure benchmark was not judged to represent a change from prevailing conditions and the feature was judged to be 'not sensitive'.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(NS1)	(L1)	1 - This feature is subtidal and was judged to be not sensitive to the pressures benchmark.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS1)	(L1)	1 - Tidal streams are apparent down to 30m, given the strength of these and the adaptation of the community to these prevailing conditions this feature was judged to be 'not sensitive' to changes in wave exposure at the pressure benhcmark.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS1)	(L1)	1 - Tide swept channels occur in a range of locations including sea lochs and estuaries, the higher turbidity of estuaries influences species composition with fewer kelp and more red seaweeds which can tolerate lower levels of light penetration (JNCC online biotope descriptions). Although community composition is altered by water clarity, the geology and hydrodynamics which are the most obvious characterising elements are not altered. Hence this feature was judged to be not sensitive to changes in water clarity.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: very high water flow dynamics, diverse epifauna (sponge and anthozoan)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(H4)	V(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: very high water flow dynamics, diverse epifauna (sponge and anthozoan)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N4)	(H4)	V(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: very high water flow dynamics, diverse epifauna (sponge and anthozoan)
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1. Elements used in assessment: very high water flow dynamics,
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(M4)	(L4)	(H4)	(H4)	(L4)	(L4)	4 - based on expert judgement from workshop 1. Elements used in assessment: very high water flow dynamics, diverse epifauna (sponge and anthozoan)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	N4	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: very high water flow dynamics, diverse epifauna (sponge and anthozoan)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(M4)	(M4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; hard to uniformly remove epifauna because they live in channels. Elements used in assessment: very high water flow dynamics, diverse epifauna (sponge and anthozoan)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(M4)		(H4)	(M4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: very high water flow dynamics, diverse epifauna (sponge and anthozoan)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1. Elements used in assessment: very high water flow dynamics, diverse epifauna (sponge and anthozoan)
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Visual disturbance	None proposed					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - scope for INS to establish but unlikely to dominate in high energy environments
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1 - Some features could be targeted (e.g. kelp, mussels) but others would not be
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L-H1)	(L1)	(M-H1)	(L1)	(NS-M1)	(L1)	1 - Could be significant removal of non-target species (e.g. with mussel removal); non-target features would be less affected by (e.g. seaweed harvesting)

3.1 *Alcyonium hibernicum*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(M1)	(L1)	
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1; Hartnoll 1977
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NE4)	(L1)	4 - based on expert judgement from workshop 1; Hartnoll 1977
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; Hartnoll 1977

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(H4)	(H4)	(L4)	(NS1) (NS4)	(L4)	1 - Not Sensitive to this pressure benchmark 4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(H4)	(M4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
Physical damage	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
Physical damage	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
...er physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
...er physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
...er physical pressures	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
...er physical pressures	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Oth	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Potentially at risk from some INS
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; feature occupies vertical walls and overhangs, unlikely to be removed although could suffer abrasion from fixed gears

3.2 *Alkmaria romijni*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark; Occupies habitats where salinity can be highly variable (lagoons and estuaries- evidence from MarLIN)
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.1)
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.1)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.1)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.1)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.1)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(M3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.1)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N1)	(M1)	(VL1)	(M1)	(H1)	(M1)	1 - This species is very habitat specific with limited distribution, it is therefore judged to have no resistance to physical change and given limited distribution may not recruit following habitat recovery (information from MarLIN).
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N1)	(H1)	(VL1)	(H1)	(H1)	(H1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(H1)	(L1)	1 - The species is sessile, inhabitating a tube, and is considered unliely to re-surface following burial, the species occurs in sheltered habitats so it is unlikely that the deposit would be reoved in the short term by current action.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(H3)	(L1)	3 - Refer to Marlin evidence, Annex H, Section 3.1
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Based on assessment for surface abrasion.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Based on assessment for surface abrasion.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Species inhabitats a tube at the sediment surface and would be exposed and damaged by surface abrasion, due to small size a proportion of the species would be expected to survive impact and to replenish population..
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(L1)	(L1)	(M1)	(L1)	(H1)	(L1)	1 - Extraction of sediment would remove this species, recovery is predicted to be low due to limited distribution of species.
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Could be affected by Perophora japonica which may smother up to 10% of sea bed

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	

3.3 *Amphianthus dohrnii*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(H1)	(L1)	1 - The species is functionally dependent on *Swiftia pallida* and therefore this assessment was based on northern Sea Fan communities (see Annex G, Section 2.24).
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
re/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L1)	(L1)	(L1)	(L1)	(H1)	(L1)	
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.2)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshor	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(H4)	(H4)	(L4)	(NS1) (NS4)	(L4)	1 - Not Sensitive to this pressure benchmark 4 - based on expert judgement from workshop 1
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(L4)	(L4)	(L4)	(M4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(L1)	(L1)	(M1)	(L1)	1 - Assessment as for host species Eunicella
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(N4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1

3.4 *Anotrichium barbatum*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 Assessed as part of initial matrix blockfilling.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(M1)	(L1)	
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(L4)	(M4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(N4)	(M4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L4)	(M4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(L4)	(M4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(N4) (L4)	(M4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(M4)	(NS1) (NS4)	(M4)	4 - based on expert judgement from workshop 1
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N2) (N4)	(L2) (M4)	(VL2) (L4)	(L2) (L4)	(H2) (H4)	(L2) (L4)	2 - based on MarLIN and ABPmer judgement 4 - based on expert judgement from workshop 1
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(L4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(H5)	(L)	4 - based on expert judgement from workshop 1 5 - Based on expert judgement from CCW.
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(M4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L2) (L4)	(L2) (L4)	(L2) (L4)	(L2) (L4)	(H2) (H4)	(L2) (L4)	2 - based on MarLIN and ABPmer judgement 4 - based on expert judgement from workshop 1
Physical damage	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(H1)	(L1)	1- Based on the assessments that were made for other abrasion and disturbance pressures it was judged that this attached, surface living feature would be highly sensitive to surface abrasion.
Physical damage	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(M4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
pressures	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical p	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M5)	(L1)	1 - Habitat may be susceptible to INS but unlikely to dominate assemblage 5 - Based on expert judgement from CCW.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(M1)	(H1)	(L1)	(NS1)	(L1)	1 - Not targeted directly
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M1) (M4)	(L4)	(L4) (M1)	(L4)	(M1) (M4)	(L4)	4 - based on expert judgement from workshop 1

3.5 *Archnanthus sarsi*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					NA	(L)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H3)	(L)	
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H3) (H4)	(L4)	(H3) (H4)	(L4)	(NS3) (NS4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 3.3) 4 - based on expert judgement from workshop 1
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L3) (L4)	(L4)	(L3) (M4)	(L4)	(H3) (M4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 3.3) 4 - based on expert judgement from workshop 1. As the project specification was to develop an expert judgement based approach we have presented the workshop assessment in the matrix, however compared with MarLIN's evidence based approach, this may underestimate sensitivity.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(N3)		(L3)		(H3) (NE4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 3.3) 4 - based on expert judgement from workshop 1
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L3) (H4)	(L4)	(L3) (H4)	(L4)	(H3) (NS4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 3.3) 4 - based on expert judgement from workshop 1 To reconcile the differing assessments the most precautionary judgement was used in the matrix.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H3) (H4)	(L4)	(H3) (H4)	(L4)	(NS1) (NS3) (NS4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 3.3) 4 - based on expert judgement from workshop 1
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3) (L4)	(L4)	(H3) (M4)	(L4)	(NS3) (M4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 3.3) 4 - based on expert judgement from workshop 1. As the project specification was to develop an expert judgement based approach we have presented the workshop assessment in the matrix, however compared with MarLIN's evidence based approach, this may overestimate sensitivity.
	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical changes	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(L4)	(H4)	(L4)	(NS1) (NS4)	(L4)	1 - Not Sensitive to this pressure benchmark 4 - based on expert judgement from workshop 1
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(H4)	(L4)	(M4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop 1
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
ge	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H3) (M4)	(L4)	(H3) (M4)	(L4)	(NS3) (M4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 3.3) 4 - based on expert judgement from workshop 1.s the project specification was to develop an expert judgement based approach we have presented the workshop assessment in the matrix, however compared with MarLIN's evidence based approach, this may overestimate sensitivity.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical dama	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(H4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(H4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; recovery based on fragmented population
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Habitat unlikely to be colonized by known INS
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(M1)	(H1)	(M1)	(NS1)	(M1)	1 - May occur in areas of scallop fisheries
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L4)	(L4) (M1)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; Hall et al, CCW report; CEDaR Annual Report 2007-08. Presumed recovery from recruitment and local propagation

3.6 *Arctica islandica*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.4)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
re/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.4)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.4)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.4)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshor	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(M3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.4)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H4)	(H4)	(H4)	(H4)	(NS1) (NS4)	(H4)	1 - Not Sensitive to this pressure benchmark 4 - based on expert judgement from workshop 1; Diaz & Rosenburg (1995)
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(L2)	(L2)	(L2)	(L2)	(H2)	(L2)	2 - As change is for two years, large adults may survive but recruitment low
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(M3) (NS4)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.4) 4 - based on expert judgement from workshop 1. As the project specification was to develop an expert judgement based approach we have presented the workshop assessment in the matrix, however compared with MarLIN's evidence based approach, this assessment may underestimate sensitivity.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(H4)	(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1; Rumohr and Krost 1991.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4)	(H4)	(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1; Kaiser and Spencer (1994)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(H4)	(L4)	(H4)	(L4)	(NS1) (NS4)	(L4)	1 - Not Sensitive to this pressure benchmark 4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N2) (N4)	(L2) (M4)	(L2) (L4)	(M4)	(H2) (H4)	(M4)	4 - based on expert judgement from workshop 1; OSPAR Review (2008), Witbaard *et al.* (1994) ICES Jour.Mar.Sci
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted; removal of key predators (e.g. wolffish) may increase abundance?
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1)	(L1)	(L1)	(L1)	(H1)	(L1)	1; feature commonly taken as bycatch in beam trawls and slow to recover

3.7 *Armandia cirrhosa*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.5)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					No Evid.	(L)	1 - No evidence
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.5)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.5)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					No Evid.	(L)	1 - No evidence
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.5)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.5)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M1)	(L1)	
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					No Evid.	(L)	1 - No evidence
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.5)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.5)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.5)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(L1)	(L1)	(M1)	(L1)	(H1)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.5)
pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical p	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Could be affected by INS such as Perophora japonica which may smother up to 10% of sea bed
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	

3.8 *Atrina pectinata*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.21)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.21)
(inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.21)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.21)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.21)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(M3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.21)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m^2/yr	(M4)	(L4)	(L4)	(L4)	(NS1) (M4)	(L4)	1 - Not Sensitive to this pressure benchmark 4 - based on expert judgement from workshop 1. As the project specification was to develop an expert judgement based approach we have presented the workshop assessment in the matrix, however compared with MarLIN's evidence based approach, this may overestimate sensitivity.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M4)	(L4)	(L4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(VL4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(L4)	(VL4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(L4)	(VL4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; Eno *et al.* (2001) ICES Journal Marine Science
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(L4)	(VL4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(L1)	(L1)	(H1)	(L1)	1 - Habitat may be affected by INS. Slow recovery
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted;
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1)	(L1)	(L1)	(L1)	(H1)	(L1)	1 - may be removed as by-catch with low recovery

3.9 *Caecum armoricum*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment: Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L1)	(L1)	(L1)	(L1)	(H1)	(L1)	Occupies niche environment - unlikely to be able to withstand significant environmental variations
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					No Evid.	(L)	Insufficient information
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L1)	(L1)	(L1)	(L1)	(H1)	(L1)	Occupies niche environment - unlikely to be able to withstand significant environmental variations
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L1)	(L1)	(L1)	(L1)	(H1)	(L1)	Occupies niche environment - unlikely to be able to withstand significant environmental variations

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(L1)	(L1)	(L1)	(L1)	(H1)	(L1)	Occupies niche environment - unlikely to be able to withstand significant environmental variations
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	N1	H1	(L1)	(L1)	(H1)	(M1)	Specific to shingle. Isolated population so recovery likely to be low
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	N1	H1	(L1)	(L1)	(H1)	(M1)	Specific to shingle. Isolated population so recovery likely to be low
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(L1)	(M1)	(L1)	(L1)	(H1)	(L1)	This species is found in the spaces between small (1-2 cm) pebbled (MarLIN) in an environment that is therefore freely draining and with low organic content, there is no evidence to assess but it is likely this species would be sensitive to the addition of fine materials.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L1)	(M1)	(L1)	(L1)	(H1)	(L1)	This species is found in the spaces between small (1-2 cm) pebbled (MarLIN) in an environment that is therefore freely draining and with low organic content, there is no evidence to assess but it is likely this species would be sensitive to the addition of fine materials.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	resistance- medium-lives in interstitial spaces in pebbles no information ondepth but likely to be adapted to living in a distrurbed environment with abrasive forces- small size suggests short lived, medium resileicne to be pre-cautionary- no evidence on life history available
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	resistance- medium-lives in interstitial spaces in pebbles no information ondepth but likely to be adapted to living in a distrurbed environment with abrasive forces- small size suggests short lived, medium resileicne to be pre-cautionary- no evidence on life history available

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	lives interstitially - unlikely to be sensitive to surface abrasion
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N1)	(L1)	(VL1)	(L1)	(H1)	(L1)	Removal of the substrate would remove the habitat of this species and extract the population. The species has a limited distribution (recorded at one location) so that recovery from outside recruitment would be unlikely, recovery was therefore judged to be very low.
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Other physical pressures	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Other physical pressures	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Other physical pressures	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Other physical pressures	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	Could be affected by Perophora japonica which may smother up to 10% of sea bed
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Feature not targeted;
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Feature too small to be retained

3.10 *Cruoria cruoriaeformis*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s	(M1)		(M1)		(M1)	(L1)	1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100	(M1)		(M1)		(M1)	(L1)	1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - based on Maerl assessment (see Annex G, Section 2.19). Changes in water flow at the pressure benchmark are not considered to have an impact on this feature.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - based on Maerl assessment (see Annex G, Section 2.19). Is generally a shallow subtidal feature, changes in emergence at the pressure benchmark were not considered to impact this feature.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1- based on Maerl assessment (see Annex G, Section 2.19). Maerl occurs in sheltered areas where wave action is strong enough to remove fine sediments, a change in wave exposure at the pressure benchmark level is not considered to impact this feature.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L1)		(L1)		(H3) (H8)	(L1)	Based on Maerl assessment (see Annex G, Section 2.19) 3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.15) 8 - Based on expert judgement from workshop 3
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(N1)		(VL1)		(H3) (H8)	(M1)	Based on Maerl assessment (see Annex G, Section 2.19) 3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.15) 8 - Based on expert judgement from workshop 3

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Based on maerl assessment (see Annex G, Section 2.19) 1 - Changes in water flow at the pressure benchmark are not considered to have an impact on this feature.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NS	(L1)	Based on maerl assessment 1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Based on maerl assessment (see Annex G, Section 2.19) 1- Maerl occurs in sheltered areas where wave action is strong enough to remove fine sediments, a change in wave exposure at the pressure benchmark level is not considered to impact this feature.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(H8)	(L)	Based on maerl assessment (see Annex G, Section 2.19) 8 - Based on expert judgement from workshop 3
chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other c	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(M4)	(L4)	(M4)	(L4)	(NS1) (M4)	(L4)	4 - based on expert judgement from workshop 1
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N7)	(L7)	(VL7)	(M7)	(H7)	(L7)	Based on maerl assessment (see Annex G, Section 2.19) 7 - based on expert judgement from workshop 2
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N1)	(H1)	(VL1)	(H1)	(H1)	(H1)	Based on maerl assessment (see Annex G, Section 2.19) 1 - Maerl is judged be highly sensitive to loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(N7)		(L7)		(H3) (H8)	(L)	Based on maerl assessment (see Annex G, Section 2.19) 3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.15) 8 - Based on expert judgement from workshop 3
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(H1) (H5)	(L1)	1 - based on assessment for low siltation 5 - Based on expert judgement from external review

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N1) (N-L7)	(H1) (M7)	(VL1) (VL7)	(H1) (M7)	(H1) (H7)	(H1) (M7)	Based on maerl assessment (see Annex G, Section 2.19) 1 - Based on expert judgement of maerl general characteristics, feature occurs on surface so would be highly exposed to penetration and disturbance. Maerl species in general are fragile and do not tolerate burial. Maerl species are very slow growing species, hence recovery times would be long. 7 - based on expert judgement from workshop 2; Jason Hall-Spencer papers
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N-L7)	(M7)	(VL7)	(M7)	(H1) (H7)	(M7)	Based on maerl assessment (see Annex G, Section 2.19) 1 - Based on work carried out by Hall et al 2008, maerl is highly sensitivie to heavy abrasion pressures. 7 - based on expert judgement from workshop 2; Jason Hall-Spencer papers e.g. Hall-Spencer and Moore 2000.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L7)	(L7)	(L7)	(L7)	(H7)	(L7)	Based on maerl assessment 7 - based on expert judgement from workshop 2
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N7)	(M7)	(VL7)	(M7)	(H5) (H7)	(M7)	Based on maerl assessment (see Annex G, Section 2.19) 5 - Based on expert judgement from external review 7 - based on expert judgement from workshop 2
pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical p	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(H1)	(L1)	1 - Assessment based on maerl (see Annex G, Section 2.19)
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NE	(L1)	1. Not targeted directly so assessed as not exposed.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L4)	(M4)	(L1) (M4)	(L4)	(H1) (M4) (H5)	(L4)	1 - recovery may be slow if dependent on recovery of maerl 4 - based on expert judgement from workshop 1; Jason Hall-Spencer papers 5 - Based on expert judgement from external review

3.11 *Dermocorynus montagnei*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(H1)	(L1)	
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(H1) (H3) (H8)	(L1)	
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(M5)	(L1)	5 - Based on expert review.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; similar order of magnitude that species would generally be used to anyhow.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N2)	(L2)	(VL2)	(L2)	(H2)	(L2)	2 - based on MarLIN and ABPmer judgement
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(H1)	(L1)	
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(H5)	(L1)	5 - Based on expert judgement from external review
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(H1)	(L1)	
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(H1)	(L1)	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(H1)	(L1)	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N2)	(L2)	(VL2)	(L2)	(H2)	(L2)	2 - based on MarLIN and ABPmer judgement
pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical p	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Habitat may be suceptible to INS but unlikely to dominate assemblage
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS/ NE1)	(L1)	1 - Not exposed to this pressure benchmark- feature is not a commercially targeted species.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H4)	(M4)	(H4)	(M4)	(NS1) (NS4)	(M1)	1 - this species occurs on mobile stones and must therefore be resistant and able to recover from disturbance. It would be expected to be resistant to removal unless substrate is also removed 4 - based on expert judgement from workshop 1

3.12 *Edwardsia timida*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	
Climate change	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Temperature changes regional/national	1.5-4°C increase by 2100					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
Climate change	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(M1)	(L1)	
Climate change	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
ore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H4)	(M4)	(M4)	(L4)	(L4)	(L4)	4 - based on expert judgement from workshop 1; Hiscock papers on MarClim
ore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (insh	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(M4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; Moore 1977
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H4)	(L4)	(H4)	(L4)	(NS1) (NS4)	(L4)	4 - based on expert judgement from workshop 1
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(N4)	(M4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(M4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical p	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Potentially susceptible to smothering by INS
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1) (H4)	(L4)	(M1) (H4)	(L4)	(M1) (NS4)	(L4)	1 - If scallop dredging activity occurs in the relevant habitats, sensitivity may be medium 4 - based on expert judgement from workshop 1. To reconcile the differing assessments the most precautionary judgement was used in the matrix.

3.13 *Eunicella verrucosa*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. The feature is found in area where tidal streams are moderately strong (JNCC online biotope description- see references), and was therefore judged to be not sensitive to the pressure benchmark.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. The feature is found in area where wave exposure ranges from moderately to extremely exposed (JNCC online biotope description- see references), and was therefore judged to be not sensitive to the pressure benchmark.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H3) (H4)	(L4)	(H3) (H4)	(L4)	(NS1) (NS3) (NS4)	(M4)	1 - Not Sensitive to this pressure benchmark 3 - Refer to Marlin evidence (see Annex H, Section 3.6) 4 - based on expert judgement from workshop 1; Ferrier et al 2009
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS1)	(L1)	1 - The feature is found in area where tidal streams are moderately strong (JNCC online biotope description- see references), and was therefore judged to be not sensitive to the pressure benchmark.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(NS1)	(L1)	1 - The feature is found in area where wave exposure ranges from moderately to extremely exposed (JNCC online biotope description- see references), and was therefore judged to be not sensitive to the pressure benchmark.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(L4)	(L4)	(L4)	(L4)	(H1) (H4)	(L4)	4 - based on expert judgement from workshop 1
	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical changes	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(H4)	(H4)	(L4)	(NS1) (NS4)	(L4)	4 - based on expert judgement from workshop 1
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; CCW research reports
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(L4)	(L4)	(L4)	(M4)	(H4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 3.6) 4 - based on expert judgement from workshop 1
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical d	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(L1)	(M1)	(M1)	(L1)	1 - Potential for interaction with Crepidula in some locations
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Not Sensitive to this pressure benchmark
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(N4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; Lyme Bay reports

3.14 *Gammarus insensibilis*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100	(H3)	(L1)	(M3)	(L3)	(L3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.7)
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	This species is restriced to saline lagoons and hence the exposure assessments for that feature were adopted here (see Annex G 2.25).
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NE1)	(L1)	1 - Lagoons are naturally sheltered and subject only to limited wind-driven waves; changes are unlikely to be significant-hence the feature was judged as 'Not Exposed'.
re/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H3)	(L1)	(M3)	(L3)	(L1) (L3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.7).
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(H1)	(L1)	(M1)	(L1)	(L1)	(L1)	1. This species is a lagoonal specialist and is juded to be adapted to regular salinity fluctuations.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	This species is restriced to saline lagoons and hence the exposure assessments for that feature were adopted here (see Annex G 2.25).

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshor	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	This species is restriced to saline lagoons and hence the exposure assessments for that feature were adopted here (see Annex G 2.25).
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	This species is restriced to saline lagoons and hence the exposure assessments for that feature were adopted here (see Annex G 2.25).
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(L3)	(L3)	(L3)	(H3)	(H3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 3.7); could affect growth of habitat feature - Chaetomorpha linum
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(H1)	(M1)	(H1)	(M1)	(NS1)	(M1)	1 - Occupies a wide range of sediment type from organic muds to shingle with varying mixtures of sand, silt and clay
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 3.7)
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(L1)	(M1)	(L1)	(M1)	(H1)	(M1)	1 - Heavy siltation would result in loss of Chaetomorpha linum a key habitat component
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L1)	(M1)	(L1)	(M1)	(H1)	(M1)	1 - Loss of Chaetomorpha linum would remove key habitat feature
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L1)	(M1)	(L1)	(M1)	(H1)	(M1)	1 - Loss of Chaetomorpha linum would remove key habitat feature
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L1)	(M1)	(L1)	(M1)	(H1)	(M1)	1 - Loss of Chaetomorpha linum would remove key habitat feature
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(L1)	(M1)	(L1)	(M1)	(H1)	(M1)	1 - Loss of Chaetomorpha linum would remove key habitat feature
cal pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physic	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 -Association with haetomorpha suggests they are unlikely to move over significant distances except for seasonal movements
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - Unlikely to be exposed to pressure; organism is small and thus more likely to be swept past rotating blades
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - Could be affected to small degree by low salinity INS such as Perophora japonica
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 Feature small and motile and should be able to avoid commercial fishing gears- the use of which would be limited in saline lagoons.

3.15 *Gitanopsis bispinosa*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment: Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
d other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical	Shallow abrasion/penetration: damage to seabed surface and penetration ≤25mm	Damage to seabed surface and penetration ≤25mm					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.

3.16 *Glossus humanus*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km^2 or 50% of width of water body for more than 1 year	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - Habitat (mud/sandy mud) could be affected by changes in flows
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - Habitat (mud/sandy mud) could be affected by changes in waves
es (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - fully marine species; unlikely to be sensitive to minor increases in salinity; unlikely to be exposed to significant reductions in salinity
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km^2 or 50% of width of water body for more than 1 year	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - Habitat (mud/sandy mud) could be affected by changes in flows

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological change	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - Habitat (mud/sandy mud) could be affected by changes in waves
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Occurs in relatively clear water and thus may not be tolerant of increases in turbidity
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H4)	(L4)	(H4)	(L4)	(NS1) (NS4)	(L4)	1 - Not Sensitive to this pressure benchmark 4 - based on expert judgement from workshop 1
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Change in sediment type could affect abundance - restricted to mud/sandy mud habitats
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(H4)	(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4)	(H4)	(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(H4)	(L4)	(H4)	(L4)	(NS4)	(L4)	4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1
pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical p	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Habitat could be affected by INS
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Feature may be retained as bycatch

3.17 *Gobius cobitis*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS3)	(L)	3 - Refer to Marlin evidence, Annex H, Section 3.8
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence, Annex H, Section 3.8
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(M3)		(H3)		(L3)	(M3)	3 - Refer to Marlin evidence, Annex H, Section 3.8
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L3)	(L)	3 - Refer to Marlin evidence, Annex H, Section 3.8
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H3)		(H3)		(NS3)	(L)	3 - Refer to Marlin evidence, Annex H, Section 3.8

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence, Annex H, Section 3.8
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence, Annex H, Section 3.8
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(L3)	(L)	3 - Refer to Marlin evidence, Annex H, Section 3.8
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(L3)	(L)	3 - Based on MarLIN assessment (see Annex H, Section 3.8)
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(L1)	(L1)	1 - Based on MarLIN assessment for low siltation, taking into account the mobility of species that means it is expected to be able to avoid smothering.
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Based on assesment for light abrasion, species lives on surface and therefore all bed disturbing activities are judged to have a similar impact.
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Based on assesment for light abrasion, species lives on surface and therefore all bed disturbing activities are judged to have a similar impact.
Physical damage	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - The species is mobile and a proportion of the population is judged to be able to evade activities disturbing the sediment/substrate. Given mobility and the use of a variety of habitats the population would be expected to recover, sexual maturity is not reached until 2-3 years (Natural England 2010) although recruitment from outside impacted area may occur. The spatial scale of activity will modify sensitivity.
Physical damage	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Based on assesment for light abrasion, species lives on surface and therefore all bed disturbing activities are judged to have a similar impact.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site	(N1)	(M1)	(H1)	(L1)	(M1)	(L1)	1 - gobies have low hearing sensitivity (Nedwell, 2007). Strong avoidance reaction to source noise level for a dstance of 200m+, but likely to return once noise abates
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					(L1)	(L1)	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Fish generally at risk from cooling water intake structures
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 -Not Sensitive to this pressure benchmark

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(NE1)	(L1)	1 -Occurs in tidal rock pools on upper shore
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(NE1)	(L1)	1 - Occurs in tidal rock pools on upper shore

3.18 *Gobius couchi*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.9)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.9)
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	M3		(H3)		(L3)	(M3)	3 - Refer to Marlin evidence (see Annex H, Section 3.9)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.9)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H3)		(H3)		(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.9)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 3.9)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 3.9)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.9)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(L3)	(L)	3 - Based on MarLIN assessment (see Annex H, Section 3.9)
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(L1)	(L1)	1 - Based on MarLIN assessment for low siltation for Gobius couchi (see Annex G 3.18), taking into account the mobility of species that means it is expected to be able to avoid smothering.
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(M1)	(L1)	
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(M1)	(L1)	
Physical damage	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(M1)	(L1)	
Physical damage	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(M1)	(L1)	
ssures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ssures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pre	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site	(N1)	(M1)	(H1)	(L1)	(M1)	(L1)	1 - gobies have low hearing sensitivity (Nedwell, 2007). Strong avoidance reaction to source noise level for a dstance of 200m+, but likely to return once noise abates
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					(L1)	(L1)	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Fish generally at risk from cooling water intake structures
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Not Sensitive to this pressure benchmark
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Too small to be colelcted in trawls; thus few records

3.19 *Haliclystus auricular*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - The sensitivity assessment is based on the habitat of the species using assessments made for seagrass beds (see Annex G, Section 2.31).
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - This feature is found on macroalgae and seagrass, the sensitivity assessments are therefore based on the habitat of the species using assessments made for seagrass beds (see Annex G, Section 2.31) and kelp and seaweed communities on sediment (see Annex G, Section 2.17)
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(L1)	(L1)	1 - The sensitivity assessment based on the habitat of the species using assessments made for kelp and seaweed communities on sediment (see Annex G, Section 2.17)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(H1)	(L1)	1 - Based on sensitivity assessments of seagrass beds (see Annex G, Section 2.31).
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M1)	(L1)	1 - Based on sensitivity assessments of seagrass beds (see Annex G, Section 2.31) as the most pre-cautionary assessment.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(L1)	(L1)	1 - The sensitivity assessments are based on the habitat of the species using assessments made for seagrass beds (see Annex G, Section 2.31) and kelp and seaweed communities on sediment (see Annex G, Section 2.17)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS1)	(L1)	1 - The sensitivity assessments are based on the habitat of the species using assessments made for seagrass beds (see Annex G, Section 2.31) and kelp and seaweed communities on sediment (see Annex G, Section 2.17)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(L1)	(L1)	1 - The sensitivity assessment based on the habitat of the species using assessments made for kelp and seaweed communities on sediment (see Annex G, Section 2.17)
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(M1)	(L1)	1 - Based on sensitivity assessments of seagrass beds (see Annex G, Section 2.31) as the most pre-cautionary assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(M1)	(L1)	1 - Based on sensitivity assessments of seagrass beds (see Annex G, Section 2.31) as the most pre-cautionary assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(M1)	(L1)	1 - Based on sensitivity assessments of seagrass beds (see Annex G, Section 2.31) as the most pre-cautionary assessment.
emical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other ch	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M1)	(L1)	1 - The sensitivity assessment based on the habitat of the species using assessments made for kelp and seaweed communities on sediment (see Annex G, Section 2.17)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(H1)	(L1)	1 - Assessment based on seagrass sensitivity (see Annex G, Section 2.31).
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(H1)	(L1)	1 - Assessment based on seagrass sensitivity (see Annex G, Section 2.31).

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(H1)	(L1)	1 - Assessment based on seagrass sensitivity (see Annex G, Section 2.31) taking into consideration that abrasion that did not remove seagrass may still damage attached species.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(H1)	(L1)	1 - Assessment based on seagrass sensitivity (see Annex G, Section 2.31).
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Unclear whether feature attaches to INS macroalgae
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(H1)	(H1)	(H1)	(NS1)	(H1)	1 - Assessment based on seagrass sensitivity (see Annex G, Section 2.31); 1 - biotope features not targeted directly
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1)	(H1)	(L1)	(H1)	(H1)	(H1)	1 - Assessment based on seagrass sensitivity (see Annex G, Section 2.31)

3.20 *Hippocampus guttulatus*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Assessment based on the sensitivity of key habitat elelments (see Annex G, Section 2.31, seagrass)
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(M3)	(L)	
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Feature is subtidal and not exposed to this pressure benchmark.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M1)	(L1)	1 - Assessment based on the sensitivity of key habitat elelments (see Annex G, Section 2.31, seagrass)
s (inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 3.10)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 3.10)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(M1)	(L1)	1 - Assessment based on the sensitivity of key habitat elelments (see Annex G, Section 2.31)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 3.10)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	N2		(M2)		(M2)	(L)	
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence (see Annex H, Section 3.10)
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(M2)	(L)	
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(M2)	(L)	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(M2)	(L)	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(M2)	(L)	
ysical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other phy	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site	(N1)	(L1)	(H1)	(L1)	(M1)	(L1)	1 - hearing sensitivity of seahorses is uncertain, but likely to be hearing insesntive. Strong avoidance reaction to source noise level for a dstance of 200m+, but Imay return once noise abates
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					(M1)	(L1)	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure	(L1)	(L1)	(L1)	(L1)	(H1)	(L1)	1 - Fish generally at risk from cooling water intake structures
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Seagrass habitat likely to be most sensitive element rather than fish
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1)	(H1)	(L1)	(H1)	(H1)	(H1)	1 - based on seagrass assessment

3.21 *Hippocampus hippocampus*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Assessment based on the sensitivity of key habitat elelments (see Annex G, Section 2.31, seagrass)
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(M3)	(L)	
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Feature is subtidal and not exposed to this pressure benchmark.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M1)	(L1)	1 - Assessment based on the sensitivity of key habitat elelments (see Annex G, Section 2.31, seagrass)
ore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (Annex H, Section 3.11)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					No evid.	(L)	3 - Refer to Marlin evidence (Annex H, Section 3.11)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(L3)		(M3)		(M3)	(L3)	3 - Refer to Marlin evidence (Annex H, Section 3.11)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (insh	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(M1)	(L1)	1 - Assessment based on the sensitivity of key habitat elelments (see Annex G, Section 2.31, seagrass)
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence (Annex H, Section 3.11)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M2)	(L)	1 - Based on assessments made for Hippocampus guttulatus (see Annex G, Section 3.20)
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(H3)		(H3)		(NS3)	(L3)	3 - Refer to Marlin evidence (Annex H, Section 3.11)
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(M1)	(L1)	1 - Based on assessments made for Hippocampus guttulatus (see Annex G, Section 3.20)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(M1)	(L1)	1 - Based on assessments made for Hippocampus guttulatus (see Annex G, Section 3.20)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(M1)	(L1)	1 - Based on assessments made for Hippocampus guttulatus (see Annex G, Section 3.20)
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(M1)	(L1)	1 - Based on assessments made for Hippocampus guttulatus (see Annex G, Section 3.20)
ysical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other phy	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site	(N1)	(L1)	(H1)	(L1)	(M1)	(L1)	1 - hearing sensitivity of seahorses is uncertain, but likely to be hearing insesntive. Strong avoidance reaction to source noise level for a dstance of 200m+, but lmay return once noise abates
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					(M1)	(L1)	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure	(L1)	(L1)	(L1)	(L1)	(H1)	(L1)	1 - Fish generally at risk from cooling water intake structures
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Seagrass habitat likely to be most sensitive element rather than fish species
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1)	(H1)	(L1)	(H1)	(H1)	(H1)	1 - based on seagrass assessment

3.22 *Leptopmetra celtica*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment: Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Temperature changes regional/national	1.5-4°C increase by 2100					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
Climate change	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
d other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					No Evid	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					No Evid	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					No Evid	(L)	
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					No Evid	(L)	
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					No Evid	(L)	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					No Evid	(L)	

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					No Evid	(L)	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological press	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.

3.23 *Leptopsammia pruvoti*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment: Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L4)	(M4)	V(L4)	(M4)	(H3) (H4)	(M4)	3 - Refer to Marlin evidence (see Annex H, Section 3.12) 4 - based on expert judgement from workshop 1
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L4)	(M4)	(L4)	(M4)	(H3) (H4)	(M4)	3 - Refer to Marlin evidence (see Annex H, Section 3.12) 4 - based on expert judgement from workshop 1
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(H4)	(M4)	(H4)	(M4)	(NS3) (NS4)	(M4)	3 - Refer to Marlin evidence (see Annex H, Section 3.12) 4 - based on expert judgement from workshop 1
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N1)	(H1)	(VL1)	(M1)	(H1)	(M1)	1. This species is confined to rock substrates and would therefore resistance to a change in seabed type is judged to be none, there is good habitat evidence available (e.g. Jackson 2008). The recovery is based on assessments made at workshop 1 for recovery from siltation rate changes as these are judged relevant to recovery generally
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M4)	(M4)	(L4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; reports from NE on Lundy no-take-zone, Hiscock, Haskins et al
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(M4)	(VL4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; this is more likely to be a suspended sediment problem than a smothering effect due to underhang locations
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1 on heavy abrasion pressures as this is judged to be equivalent (both pressures damage surface features) the feature is judged to be equally (more) sensitive to this habitat damaging
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(M4)	(VL4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; unlikely to experience this but catastrophic if it did
Physical damage	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(L4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1 on heavy abrasion pressures as this is judged to be equivalent (both pressures damage surface features) the feature is judged to be equally (more) sensitive to this habitat damaging pressure; however unlikely to be extracting vertical bedrock walls
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Potentially at risk from some INS
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H4)	(M4)	(H4)	(M4)	(NS1) (NS4)	(M4)	1 - feature occupies vertical walls and overhangs, unlikely to be removed although could suffer abrasion from fixed gears 4 - based on expert judgement from workshop 1

3.24 *Lithothamnion coralloides*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Based on maerl assessment 1 - Changes in water flow at the pressure benchmark are not considered to have an impact on this feature.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Based on maerl assessment 1 - Maerl can occur in the low intertidal, but is generally a shallow subtidal feature, changes in emergence at the pressure benchmark were not considered to impact this feature.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Based on maerl assessment 1- Maerl occurs in sheltered areas where wave action is strong enough to remove fine sediments, a change in wave exposure at the pressure benchmark level is not considered to impact this feature.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L1)		(L1)		(H3) (H8)	(L1)	Based on maerl assessment 3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.15) 8 - Based on expert judgement from workshop 3
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(N1)		(VL1)		(H3) (H8)	(M1)	Based on maerl assessment 3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.15) 8 - Based on expert judgement from workshop 3

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Based on maerl assessment 1 - Changes in water flow at the pressure benchmark are not considered to have an impact on this feature.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NS	(L1)	Based on maerl assessment 1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Based on maerl assessment 1- Maerl occurs in sheltered areas where wave action is strong enough to remove fine sediments, a change in wave exposure at the pressure benchmark level is not considered to impact this feature.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(H8)	(L1)	Based on maerl assessment 8 - Based on expert judgement from workshop 3
and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(H5)	(L)	5 - Based on expert judgement from external review
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(H1)	(M1)	(L1)	(M1)	(H1)	(M1)	1 - Lithothmanion coralloides is found on a range of substrates although it should be noted that this species would be slow to colonise new substrates- the sensitivity assessment refers to the substrate that the maerl is found on.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to loss of habitat to land or freshwater
damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(H3) (H8)	(L)	Based on maerl assessment 3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.15) 8 - Based on expert judgement from workshop 3
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(H3)	(L)	3 - Based on MarLIN assessment maerl beds (for evidence see Annex H, Section 3.13), supported by expert judgement supplied by CCW.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N1) (NL7)	(H1) (M7)	(VL1) (VL7)	(H1) (M7)	(H1) (H7)	(H1) (M7)	1 - Based on expert judgement of maerl general characteristics, feature occurs on surface so would be highly exposed to penetration and disturbance. Maerl species in general are fragile and do not tolerate burial. Maerl species are very slow growing species, hence recovery times would be long. 7 - based on expert judgement from workshop 2; Jason Hall-Spencer papers

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N1) (N L7)	(H1) (M7)	(VL1) (VL7)	(H1) (M7)	(H1) (H7)	(H1) (M7)	1 - Based on work carried out by Hall et al 2008, maerl is highly sensitivie to heavy abrasion pressures. 7 - based on expert judgement from workshop 2; Jason Hall-Spencer papers e.g. Hall-Spencer and Moore 2000.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L7)	(L7)	(L7)	(L7)	(H7)	(L7)	Based on maerl assessment 7 - based on expert judgement from workshop 2
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N1) (N7)	(M7)	(VL1) (VL7)	(M7)	(H1) (H5) (H7)	(M7)	1 - Based on expert judgement of maerl general characteristics, feature occurs on surface so would have no resistance to substratum removal. Maerl species are very slow growing species, hence recovery times would be long. 5 - Based on expert judgement from external review 7 - based on expert judgement from workshop 2
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(M1)	(L1)	(L1)	(H1) (M5)	(L1)	1- OSPAR background document for maerl identifies Crepidula as threat 5 - Based on expert judgement assessment by CCW
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(H1)	(L1)	1 - Assessment based on maerl (see Annex G, Section 2.19)
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(H1)	(L1)	1 - Assessment based on maerl (see Annex G, Section 2.19)

3.25 *Lucernariopsis campanulata*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	1 - The sensitivity assessment is based on the habitat of the species using assessments made for seagrass beds (see Annex G, Section 2.31).
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - This feature is found on macroalgae and seagrass, the sensitivity assessments are therefore based on the habitat of the species using assessments made for seagrass beds (see Annex G, Section 2.31) and kelp and seaweed communities on sediment (see Annex G, Section 2.17)
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(L1)	(L1)	
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(H1)	(L1)	
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(M1)	(L1)	
(inshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(L1)	(L1)	
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(L1)	(L1)	

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(M1)	(L1)	
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(M1)	(L1)	
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(M1)	(L1)	
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M1)	(L1)	
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(H1)	(L1)	1 - This feature is found on macroalgae and seagrass, the sensitivity assessments are therefore based on the habitat of the species using assessments made for seagrass beds (see Annex G, Section 2.31) and kelp and seaweed communities on sediment (see Annex G, Section 2.17)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(H1)	(L1)	1 - This feature is found on macroalgae and seagrass, the sensitivity assessments are therefore based on the habitat of the species using assessments made for seagrass beds (see Annex G, Section 2.31) and kelp and seaweed communities on sediment (see Annex G, Section 2.17)
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(H1)	(L1)	1 - This feature is found on macroalgae and seagrass, the sensitivity assessments are therefore based on the habitat of the species using assessments made for seagrass beds (see Annex G, Section 2.31) and kelp and seaweed communities on sediment (see Annex G, Section 2.17)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(H1)	(L1)	1 - This feature is found on macroalgae and seagrass, the sensitivity assessments are therefore based on the habitat of the species using assessments made for seagrass beds (see Annex G, Section 2.31) and kelp and seaweed communities on sediment (see Annex G, Section 2.17)
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Unclear whether feature attaches to INS macroalgae
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(H1)	(H1)	(H1)	(NS1)	(H1)	1 - Assessment based on seagrass (see Annex G, Section 2.31); 1 - biotope features not targeted directly
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(L1)	(H1)	(L1)	(H1)	(H1)	(H1)	1 - Assessment based on seagrass (see Annex G, Section 2.31)

3.26 *Lucernariopsis cruxmelitensis*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark; Assessment based on Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17) as species is functionally dependent on macroalgae for attachment surface.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	1 - Assessment based on Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17) as species is functionally dependent on macroalgae for attachment surface.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark; Assessment based on Kelp and seaweed communities on sublittoral sediment (see Annex G, Section 2.17) as species is functionally dependent on macroalgae for attachment surface.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(L4)	(L)	4 - based on expert judgement from workshop 1
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS4)	(L)	4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(L4)	(L)	
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(L1) (L4)	(L)	1 - Not Sensitive to this pressure benchmark 4 - based on expert judgement from workshop 1
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(M1)	(L1)	
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(NS1) (NS4)	(L1)	
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(M4)	(L)	
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					(M4)	(L)	
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					(L1) (L4)	(L1)	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					(L1) (L4)	(L1)	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					(M4)	(L)	
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Unlikely that feature attaches to INS macroalgae

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(H1)	(H1)	(H1)	(NS1)	(H1)	1 - based on macroalgae assessments; 1 - biotope features not targeted directly
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Unlikely that host species would form important by-catch component

3.27 *Mitella policipes*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					NS	(L1)	1 - The biomass of this feature is higher in areas of high wave energy, therefore the species is considered to be not senstive to changes in water flow at the pressure benchmark.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - The biomass of this feature is higher in areas of high wave energy, therefore the species is considered to be not senstive to changes in water flow at the pressure benchmark.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NS	(L1)	1 - The species is found in the shallow subtidal and intertidal and is therefore considered to be not sensitive to changes in the emergence regine at the pressure benchmark.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NS	(L1)	1 - The biomass of this feature is higher in areas of high wave energy, therefore the species is considered to be not senstive to changes in water flow at the pressure benchmark.
nshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					NS	(L1)	1 This is a warm water species at the limit of its northerly distribution in the UK and therefore was judged to be not sensitive to warm waters (Morvan Barnes 2009)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - The biomass of this feature is higher in areas of high wave energy, therefore the species is considered to be not senstive to changes in water flow at the pressure benchmark.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ir	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NS	(L1)	1 - The species is found in the shallow subtidal and intertidal and is therefore considered to be not sensitive to changes in the emergence regine at the pressure benchmark.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NS	(L1)	1 - The biomass of this feature is higher in areas of high wave energy, therefore the species is considered to be not senstive to changes in water flow at the pressure benchmark.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N1)		(M1)		(M1)	(L1)	1 - Species requires hard substrate for attachment.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					NS	(L1)	1 - The species occurs on exposed rocky shores, in these areas fine sediment deposits would be naturally removed rapidly and therefore it is not expected that this species would be impacted at the pressure benchmark.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					NS	(L1)	1 - The species occurs on exposed rocky shores, in these areas fine sediment deposits would be naturally removed rapidly and therefore it is not expected that this species would be impacted at the pressure benchmark.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - This is an attached epibenthic species that would be unable to avoid disturbance at the surface.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - This is an attached epibenthic species that would be unable to avoid disturbance at the surface.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - This is an attached epibenthic species that would be unable to avoid disturbance at the surface.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - This is an attached epibenthic species that would be unable to avoid disturbance at the surface.
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - INS unliekly to colonize exposed rocky shores in significant densities

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NE	(L1)	1 - Not targeted directly; occur on exposed rocky shores
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					NE	(L1)	1 - Occur on exposed rocky shores that are not likely to support species of commercial harvest interest

3.28 *Nematostella vectensis*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - The species occurs in areas that are sheltered from water flows, changes at the benchmark level are not considered to impact this feature.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - The species occurs subtidally and is not considered to be exposed to the pressure benchmark.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NS	(L1)	1 - The species occurs in areas that are sheltered from water flows, changes at the benchmark level are not considered to impact this feature.
ore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(M3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.14)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.14)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - The species occurs in areas that are sheltered from water flows, changes at the benchmark level are not considered to impact this feature.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (insh	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - The species occurs subtidally and is not considered to be sensitive to the pressure benchmark.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NS	(L1)	1 - The species occurs in areas that are sheltered from water flows, changes at the benchmark level are not considered to impact this feature.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.14)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N1)	(H1)	(L1)	(L1)	(H1)	(L1)	1 - The species is a sessile burrower, inhabitating specific sediment types (mud), the species reporoduces asexually in the UK and recovery is limited to recruitment from existing local population, so that recovery has been judged to be low.
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					NS	(L1)	1 - The species is a burrower in fine sediments and is considered to be not sensitive to the addition of 5 cm of fine sediment
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - The species is a small sessile burrower; therefore it was judged that resistance to the addition of 30 cm of fine sediment would be medium, recovery was judged to be relatively high, but is reliant on asexual reproduction by survivors (Hill et al. 2010).
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - The species is very small and disturbance of the substrate would be unlikely to kill large numbers, leaving a source of recruits.
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	The species burrows in substrate and it was considered that the population would have low sensitivity to surface abrasion (to 25mm).
Physical damage	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - The species burrows in substrate and it was considered that the popuklation would have low sensitivity to surface abrasion (to 25mm).
Physical damage	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(L1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - The species is sessile and physical removal of the substratum would remove this
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Could be affected by Perophora japonica which may smother up to 10% of sea bed, although currently not a problem

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature is too small to be retained by fishing gears

3.29 *Ostrea edulis*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment: Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100	(H7)	(M7)	(H7)	(M7)	(NS7)	(M7)	7 - based on expert judgement from workshop 2; based on temperature variations already tolerated - assume temperature increase wont be so rapid that they can't cope
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS3) (NS7)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.15) 7 - based on expert judgement from workshop 2; increased flow may affect feeding rate in positive way, decreased flow may cause a negative effect but not a large enough change
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					(NS7)	(L)	7 - based on expert judgement from workshop 2; not sensitive to sea level rise as feed during emersion and found to depths of 20m
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(M7)	(L7)	(M7)	(M7)	(M7)	(L7)	7 - based on expert judgement from workshop 2
shore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.15)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.15)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.15)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ins	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(M3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.15)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(M7)	(L7)	(M7)	(M7)	(M7)	(L7)	7 - based on expert judgement from workshop 2
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.15)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(M4)	(NS1) (NS4)	(M4)	1 - Not Sensitive to this pressure benchmark 4 - based on expert judgement from workshop 1; more food so no negative effect. Don't live within sediment so anoxia in sediment shouldn't impact them too much
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(L4)	(H4)	(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1) (H7)	(L)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater 7 - based on expert judgement from workshop 2
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(L4)	(L4)	(VL4)	(H4)	(H3) (H4) (H7)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 3.15) 4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N4)	(L4)	(VL4)	(L4)	(H4) (H7)	(L4)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2; unable to feed
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(M4)	(VL4)	(M4)	(M1) (H4) (NS7)	(M4)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2; assumes penetration of soil and not of actual oyster, but scale does need to be considered
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4) (M7)	(M4) (L7)	(VL4) (M7)	(M4) (M7)	(M1) (H4) (M7)	(M4) (L7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2; assumes some mortality from damage
Physical damage	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M4) (M7)	(M4) (L7)	(M4) (H7)	(M4) (M7)	(M4) (M7)	(M4) (L7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2; assumes some mortality from damage
Physical damage	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4) (N7)	(M4) (M7)	(VL4) (M7)	(M4) (M7)	(M1) (H4) (M7)	(M4) (M7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2; assumes spawning allows recolonisation from remaining indivduals
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.	(L7)	(H7)	(VL7)	(M7)	(H7)	(M7)	7 - based on expert judgement from workshop 2

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L4) (L7)	(L4) (M7)	(L4) (VL7)	(L4) (M7)	(H4) (H7)	(L4) (M7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2; Assume large enough introduction and introduced individuals survive, will outcompete natives for food leading to decrease in population to level where spatting is unsuccessful. Crassostrea gigas can outcompete O. edulis but doesn't reproduce successfully at current temperatuers (re. Scotland) but if climate change increases temperatures there may be potential for successful spatting
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(N4) (N7)	(H4) (H7)	(L4) (VL7)	(H4) (H7)	(H4) (H7)	(H4) (H7)	4 - based on expert judgement from workshop 1 7 - based on expert judgement from workshop 2
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H4)	(L4)	(H4)	(L4)	(NS4) (NS7)	(L4)	4 - based on expert judgement from workshop 1; no commercially targetted species which co-exist with this feature

3.30 *Padina pavonica*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment: Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					NS	(L1)	1 - Increased temperatures may enhance reporudctive potential of this species (references cited in Hill et al. 2010)
	Salinity changes - regional/national	0.2 psu decrease by 2100	(M4)	(L4)	(L4)	(M4)	(M4)	(L4)	1 - Not Sensitive to this pressure benchmark 4 - based on expert judgement from workshop 1; see provided references
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(M4)	(L4)	(L4)	(M4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NS	(L1)	1. Occurs subtidally so increase in ASL is not judged to affect this feature.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
nshore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; references on disribution in meditteranean - seems tolerant to temperature changes in meditteranean, thought that has probably adapted to cooler conditions in the UK
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L4)	(L4)	(L4)	(M4)	(H4)	(L4)	4 - based on expert judgement from workshop 1; see provided references. More susceptible to decreases in salinity as warm water species
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(M4)	(L4)	(L4)	(M4)	(M4)	(L4)	4 - based on expert judgement from workshop 1

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (ir	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km	(L4)	(L4)	(L4)	(M4)	(H4)	(L4)	4 - based on expert judgement from workshop 1; only occurs subtidally in med, doesn't like emergence.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(N4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; prefers exopsed shores so any change would probably reduce it or it wouldn't occur
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year	(L4)	(L4)	(L4)	(M4)	(H4)	(L4)	4 - based on expert judgement from workshop 1. Reduced/removed light may mean species will not be able to grow very well. If was adaptable to this it would probably be more widespread.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(H4)	(M4)	(H4)	(H4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; not high levels of organic enrichment so assumed fairly resistant in intertidal environment
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(L4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; data from collections and local records knowledge. Don't normally grow in gravel habitats if changed to this.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M4)	(M4)	(L4)	(M4)	(M4)	(M4)	4 - based on expert judgement from workshop 1; see provided references
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(H5)	(L)	5 - based on review by external experts
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; data from collections and local knowledge; see provided references
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; data from collections and local knowledge; see provided references
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; data from collections and local knowledge; see provided references
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(L4)	(M4)	(L4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; data from collections and local knowledge; see provided references
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(L1)	(L1)	(M1)	(H1)	(L1)	1 - INS macroalgae may smother Padina

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NE	(L1)	1 - Feature is not targeted directly by a commercial fishery and hence is assessed as not exposed.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H4)	(L4)	(H4)	(M4)	(NS1) (NS4)	(L4)	1 - any harvesting activities in intertidal will be selective towards target species with minimal non-target removal 4 - based on expert judgement from workshop 1

3.31 *Palinurus elephas*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment: Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	Evidence/Justification
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100	(H1)	(M1)	(H1)	(M1)	(NS1)	(M1)	1 - Not Sensitive to this pressure benchmark
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.16)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H4)	(L4)	(H4)	(L4)	(NS3) (NS4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 3.16) 4 - based on expert judgement from workshop 1; felt not to be sensitive but no evidence
ore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; wide temperature distribution worldwide suggests low temperature sensitivity
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(L4)	(L4)	(L4)	(L4)	(H4)	(L4)	4 - based on expert judgement from workshop 1; not found in low salinity water, have assumed to need full salinity
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (insh	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H4)	(L4)	(H4)	(L4)	(NS3) (NS4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 3.16) 4 - based on expert judgement from workshop 1; felt not to be sensitive but no evidence
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr	(M4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(L4)	(M4)	(VL4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; loss of reef crevices etc would remove species
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.	(M4)	(L4)	(M4)	(L4)	(M4)	(L4)	3 - Refer to Marlin evidence (see Annex H, Section 3.16) 4 - based on expert judgement from workshop 1.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(M4)	(L4)	(M4)	(L4)	(M4)	(L4)	4 - based on expert judgement from workshop 1; range of seabed habitats where currently present, so assumed to be tolerant of changes to more silty habitats
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N4)	(H4)	V(L4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(H4)	(H4)	(H4)	(H4)	(NS4)	(H4)	4 - based on expert judgement from workshop 1
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N4)	(H4)	(VL4)	(H4)	(H4)	(H4)	4 - based on expert judgement from workshop 1
ssures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pre	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Unlikely to be sensitivie to changes in tidal excursion or temporary partial barrier
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure	(H1)	(M1)	(H1)	(L1)	(NS1)	(L1)	1 - Large crustacea are not significant by-catch in cooling water intake systems
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives	(L1)	(L1)	(L1)	(L1)	(H1)	(L1)	1 - Translocation from other areas could significantly modify local gene pool
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.	(H4)	(M4)	(H4)	(M4)	(NS1) (NS4)	(M4)	1 - Not Sensitive to this pressure benchmark 4 - based on expert judgement from workshop 1
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Habitat requirements unlikely to be particularly affected by INS
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(L4)	(M4)	(VL4)	(M4)	(H4)	(M4)	4 - based on expert judgement from workshop 1; slow growing , late maturing
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H4)	(M4)	(H4)	(M4)	(NS4)	(M4)	4 - based on expert judgement from workshop 1; no evidence that non-target species removed will have an impact

3.32 *Paludinella littorina*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M5)	(L)	5 - Based on expert judgement from review
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.17)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					(H5)	(L1)	5 - Based on expert judgement from external review
ore/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(M3) (M5)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.17) 5 - Assessment was supported by expert judgement from review
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(L3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.17)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.17)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (insh	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(L3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.17)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					(H3) (H5)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.17) 5 - Based on expert judgement from review
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(H3)	(L1)	3 - Refer to Marlin evidence (see Annex H, Section 3.17)
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(H3)	(L1)	1. Based on assessment of low siltation rates on the basis that a species highly sensitive to low siltation rates will be equally (more) sensitive to high siltation.
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
ures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological press	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Position high on shore makes it unlikely to be affected by INS
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

3.33 *Parazoanthus anguicomus*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
ges	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and other chemical chan	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.

3.34 *Phymatolithon calcareum*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	Based on maerl assessment 1 - Feature would be moderately sensitive to atmospheric climate change
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					(M1)	(L1)	Based on maerl assessment 1 - Feature would be moderately sensitive to temperature changes
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Based on maerl assessment 1 - Changes in water flow at the pressure benchmark are not considered to have an impact on this feature.
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Based on maerl assessment 1 - Maerl can occur in the low intertidal, but is generally a shallow subtidal feature, changes in emergence at the pressure benchmark were not considered to impact this feature.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Based on maerl assessment 1- Maerl occurs in sheltered areas where wave action is strong enough to remove fine sediments, a change in wave exposure at the pressure benchmark level is not considered to impact this feature.
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year	(L1)		(L1)		(H3) (H8)	(L)	Based on maerl assessment 3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.15) 8 - Based on expert judgement from workshop 3
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year	(N1)		(VL1)		(H3) (H8)	(M1)	Based on maer assessment 3 - Based on MarLIN assessment (for evidence see Annex H, Section 2.15) 8 - Based on expert judgement from workshop 3

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/local)	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Based on maerl assessment 1 - Changes in water flow at the pressure benchmark are not considered to have an impact on this feature.
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NS	(L1)	Based on maerl assessment 1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	Based on maerl assessment 1- Maerl occurs in sheltered areas where wave action is strong enough to remove fine sediments, a change in wave exposure at the pressure benchmark level is not considered to impact this feature.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(H8)	(L1)	Based on maerl assessment 8 - Based on expert judgement from workshop 3
and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					(H5)	(L1)	5 - Based on expert judgement from external review
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years	(N7)	(L7)	(VL7)	(M7)	(H1) (H7)	(L7)	1 - P. calcareum is found on a range of substrates although it should be noted that this species would be slow to colonise new substrates- the sensitivity assessment refers to the substrate that the maerl is found on. 7 - based on expert judgement from workshop 2
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat	(N1)	(H1)	(VL1)	(H1)	(H1)	(H1)	Based on maerl assessment 1 - Maerl is judged be highly sensitive to loss of habitat to land or freshwater
al damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(H3) (H8)	(L)	3 - Based on MarLIN assessment maerl beds (for evidence see Annex H, Section 3.18) 8 - Based on expert judgement from workshop 3
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(H3)	(L)	3 - Based on MarLIN assessment maerl beds (for evidence see Annex H, Section 3.18)
	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(N1) (NL7)	(H1)(M7)	(VL1) (VL7)	(H1) (M7)	(H1) (H7)	(H1) (M7)	1 - Based on expert judgement of maerl general characteristics, feature occurs on surface so would be highly exposed to penetration and disturbance. Maerl species in general are fragile and do not tolerate burial. Maerl species are very slow growing species, hence recovery times would be long. 7 - based on expert judgement from workshop 2; Jason Hall-Spencer papers

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Physica	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(N-L7)	(M7)	(VL7)	(M7)	(H1) (H7)	(M7)	Based on maerl assessment 1 - Based on work carried out by Hall et al 2008, maerl is highly sensitivie to heavy abrasion pressures. 7 - based on expert judgement from workshop 2; Jason Hall-Spencer papers e.g. Hall-Spencer and Moore 2000.
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L7)	(L7)	(L7)	(L7)	(H7)	(L7)	Based on maerl assessment 7 - based on expert judgement from workshop 2
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N7)	(M7)	(VL7)	(M7)	(H5) (H7)	(M7)	Based on maerl assessment 5 - Based on expert judgement from CCW 7 - based on expert judgement from workshop 2
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(L1)	(M1)	(L1)	(L1)	(H1) (M5)	(L1)	Based on maerl assessment 1- OSPAR background document for maerl identifies Crepidula as threat 5 - Based on expert judgement assessment by CCW
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .					(H1)	(L1)	1 - Assessment based on maerl (see Annex G, Section 2.19)
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.					(H1)	(L1)	1 - Assessment based on maerl (see Annex G, Section 2.19)

3.35 *Tenellia adspera*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					(M1)	(L1)	
	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Temperature changes regional/national	1.5-4°C increase by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark; The species is reported to be found in a wide range of temperatures (Hill et al. 2010).
	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.19)
	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
re/local)	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.19)
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.19)
	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.19)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshor	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.19)
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					(NS3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.19)
Pollution and other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					NA	(L1)	1. No assessements were obtained for this feature in workshops or review and within the project time-scale no review could be carried out. Hence this pressure x feature combination is not assessed.
Physical loss	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
Physical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(H3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.19)
Physical damage	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.					(H1)	(L1)	1 - Based on low siltation assessment.
Physical damage	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - Assessment based on light abrasion.
Physical damage	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - Assessment based on light abrasion.
Physical damage	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	1 - The species is found among algae and hydroids (MarLIN), abrasion that removed these would be damaging the specie habitat, although due to the small size of the species it is predicted that some members of the population would avoid being killed and damaged. The species is thought to have a relatively high recovery potential (Roginskaya 1970, cited in Hill et al. 2010).
Physical damage	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(N1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - The species is considered to have no resistance to removal of substratum, recovery from a severe decline was judged to be medium (2-10 years).
	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Other physical pressures	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Habitat may be colonized by INS

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targeted;
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature too small to be retained

3.36 *Victorella pavida*

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Climate change	Atmospheric climate change	Increases of 3.5-4.6°C (winter-summer) by 2050s					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	pH changes	Mean 0.2 pH decrease by 2050					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Temperature changes regional/national	1.5-4°C increase by 2100					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
Climate change	Salinity changes - regional/national	0.2 psu decrease by 2100					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Water flow (tidal & ocean current) changes - regional/national	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	This species is restriced to saline lagoons and hence the exposure assessments for that feature were adopted here (see Annex G 2.25).
Climate change	Emergence regime changes (sea level) - regional/national	Increased ASL of 21 cm by 2050 in London					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Climate change	Wave exposure changes - regional/national	A change in nearshore significant wave height >3% but <5%.					NE	(L1)	This species is restriced to saline lagoons and hence the exposure assessments for that feature were adopted here (see Annex G 2.25).
	Temperature changes - local	A 5°C change in temp for a one month period, or 2°C for one year					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
	Salinity changes - local	Increase from 35 to 38 units for one year Decrease in salinity by 4-10 units for a year					NS	(L1)	1 - This species is found in one location with highly variable salinity (Hill et al. 2010) and was therefore judged to be not sensitive to salinty changes.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Hydrological changes (inshore/loca	Water flow (tidal current) changes - local	A change in peak mean spring tide flow speed of between 0.1m/s to 0.2m/s over an area >1km² or 50% of width of water body for more than 1 year					NE	(L1)	This species is restriced to saline lagoons and hence the exposure assessments for that feature were adopted here (see Annex G 2.25).
	Emergence regime changes - local	Intertidal species (and habitats not uniquely defined by intertidal zone): A 1 hour change in the time covered or not covered by the sea for a period of 1 year. Habitats and landscapes defined by intertidal zone: An increase in relative sea level or decrease in high water level of 1 mm for one year over a shoreline length >1km					NE	(L1)	This species is restriced to saline lagoons and hence the exposure assessments for that feature were adopted here (see Annex G 2.25).
	Wave exposure changes - local	A change in nearshore significant wave height >3% but <5%					NE	(L1)	This species is restriced to saline lagoons and hence the exposure assessments for that feature were adopted here (see Annex G 2.25).
	Water clarity changes	A change in one rank, e.g. from clear to turbid for one year					No Evid.	(L)	1 - No evidence: within the scope of this project experts at the workshops were not able, or were unwilling, to make an assessment based on their knowledge and no evidence was subsequently found to support an assessment.
d other chemical changes	Non-synthetic compound contamination (incl. heavy metals, hydrocarbons, produced water)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Radionuclide contamination	10 µGy/h					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of other substances (solid, liquid or gas)	Not assessed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Pollution and	De-oxygenation	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Nitrogen and phosphorus enrichment	Compliance with WFD criteria for good status					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Organic enrichment	100gC/m²/yr					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
Physical loss	Physical change (to another seabed type)	Change in 1 folk class for 2 years					(H10)	(H10)	(H10) Suggest H as the bryozoan is entirely dependent upon hard substratum for colonisation - so a shift by one Folk class is likely to be sig and the colonies demonstrate strong annual colonisation so loss of substrata for one year could be significant. Various reports to EN & NE unpuiblished.
	Physical loss to land or freshwater habitat)	Permanent loss of existing saline habitat					(H1)	(L1)	1 - Feature would be highly sensitive to permanent loss of habitat to land or freshwater
sical damage	Siltation rate changes (Low)	5cm of fine material added to the seabed in a single event.					(M3)	(L)	3 - Refer to Marlin evidence (see Annex H, Section 3.20)
	Siltation rate changes (High)	30cm of fine material added to the seabed in a single event.	(N1)	(L1)	(VL-L1)	(L1)	(H1)	(L1)	1 - The species is currently only reported from a brackish water laggon (Carter and Jackson 2007), growing on hard surfaces, the species is attached and would be unable to escape from deposits. Resistance was therefore judged to be none-low, recovery would depend on removal of the deposit and is likely to be >2 years, hence recovery was judged to be medium. Given the limited distribution recovery from other populations is highly unlikely and would depend on recruitment from the population- to reflect this recovery is therefore judged to very low-low and hence sensitivity was assessed as high. This assessment was supported by expert review (Ian Reach, Natural England, pers comm.)

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Phy	Penetration and/or disturbance of the substrate below the surface of the seabed	Disturbance >25mm depth to 30 cm depth	(L1)	(L1)	(VL-L1)	(L1)	(H1)	(L1)	1 - The feature is an attached, epifaunal species that would be unable to avoid activities causing abrasion and was therefore judged to have low resistance to these pressures. However high recovery rates have been reported and recovery was therefore judged to take place within 2 years (Carter 2004, see also Carter and Jackson 2007). Given the limited distribution recovery from other populations is highly unlikely and would depend on recruitment from the population- to reflect this recovery is therefore judged to very low-low and hence sensitivity was assessed as high. This assessment was supported by expert review (Ian Reach, Natural England, pers comm.)
	Shallow abrasion/penetration: damage to seabed surface and penetration	Damage to seabed surface and penetration ≤25mm	(L1)	(L1)	(VL-L1)	(L1)	(H1)	(L1)	
	Surface abrasion: damage to seabed surface features	Damage to seabed surface features	(L1)	(L1)	(VL-L1)	(L1)	(H1)	(L1)	
	Physical removal (extraction of substratum)	Extraction of sediment to 30cm	(L1)	(L1)	(VL-L1)	(L1)	(H1)	(L1)	
Other physical pressures	Electromagnetic changes	Local electric field of 1V m-1 Local magnetic field of 10µT					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Litter	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of light	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year within site					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Barrier to species movement	10% change in tidal excursion, or temporary barrier to species movement over ≥ 50% of water body width.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Death or injury by collision	0.1% of tidal volume on average tide, passing through artificial structure					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.

Pressure theme	Pressure	Benchmark	Sensitivity Assessment						Evidence/Justification
			Resistance	Confidence Assessment	Resilience	Confidence Assessment	Rank/ Sensitivity	Confidence Assessment	
Biological pressures	Visual disturbance	None proposed					NA	(L1)	1 - Not Assessed. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Genetic modification & translocation of indigenous species	Translocation outside of geographic area; introduction of hatchery-reared juveniles outside of geographic area from which adult stock derives					NE	(L1)	1 - Not exposed to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction of microbial pathogens	The introduction of microbial pathogens Bonamia and *Martelia refringens* to an area where they are currently not present.					NS	(L1)	1 - Not Sensitive to this pressure benchmark. This assessment was part of initial blockfilling and hence has been accorded a default Low confidence assessment.
	Introduction or spread of non-indigenous species	A significant pathway exists for introduction of one or more Invasive non-indigenous species (INS) (e.g. aquaculture of INS, untreated ballast water exchange, local port, terminal, harbour or marina); creation of new colonization space >1ha. One or more INS in Table C3 has been recorded in the relevant habitat	(M1)	(L1)	(M1)	(L1)	(M1)	(L1)	1 - Could be affected by INS such as Perophora japonica which may smother up to 10% of sea bed; limited distribution could affect recovery
	Removal of target species	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial scale .	(H1)	(L1)	(H1)	(L1)	(NS1)	(L1)	1 - Feature not targted
	Removal of non-target species	Removal of features through pursuit of a target fishery at a commercial scale.	(M1)	(L1)	(H1)	(L1)	(L1)	(L1)	

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Annex H. MarLIN Information

Annex H Contents Tables

Habitats of conservation importance

Annex H Section	**Habitats of conservation importance**	**Biotope information**
2.1	Blue Mussel beds (including intertidal beds on mixed and sandy sediments)	MLR.MytFves; IMX.Mytv; MCR.MytHAs
2.2	Burrowed mud	Cmu.SpMeg; CFiMU.MegMax
Carbonate	reefs	None
2.3	Coastal saltmarsh	Coastal Saltmarsh:Lmu-SM
2.4	Cold-water coral reefs	Cold Water Reefs COR.Lop
2.5	Egg wrack beds	Eggwrack beds SLR_AscX_mac
2.6	Estuarine rocky habitats	SIR.Lsac.Pk; SIR.Lsac.RS; SLR.AScX.mac; SLR.Asc; MLR.BF; SLR.Fcer;
2.7	File shell beds	IMX.Lim
2.8	Fragile sponge & anthozoan communities on subtidal rocky habitats	MCR.ErSEun
2.9 Horse	mussel (*Modiolus modiolus*) beds	MCR.ModT
2.10	Inshore deep mud with burrowing heart urchins	Cmu.BriAchi
2.11	Intertidal mudflats	Lmu.HedMac; LMs.MS; LGS.Lan
2.12	Intertidal underboulder communities	MLR.Fser.Bo
2.13	Kelp and seaweed communities on sublittoral sediment	IMX.FiG;IMX.LsacX;MIR.LsacChor
2.14	Littoral chalk communities	MLR.BF;
2.15	Maerl beds	IGS.L.gla; IGS.Phy.HEC
2.16	Mud habitats in deep water	MCR.ModT
2.17	*Musculus discors* beds	MCR.Mus
2.18	Northern seafan communities	MCR.ErSEun
2.19	*Ostrea edulis* beds	SS.SMx.IMx.Ost
2.20	Peat and clay exposures	MLR.RPid; MLR.MytPid; IR.AlcByH
2.21	*Sabellaria alveolata* reefs	MLR.Salv
2.22	*Sabellaria spinulosa* reefs	SS.SBR.PoR.SspiMx
2.23	Seagrass beds	IMS.Zmar; ;IMS.Rup
2.24	Sea-pen and burrowing megafauna communities	CMu.SpMeg
2.25	Shallow tideswept coarse sands with burrowing bivalves	SS.SCS.ICS.MoeVen
2.26	Sheltered muddy gravels	Ls.LMx.Mx.CirCer; IMX.CreAph;IMX.VsenMtru
2.27	Subtidal chalk	IR.ALcByH; MCR.Pid; MCR.Pol

Species of Conservation Interest

Annex H Section	Scientific name	Common name
3.1	*Alkmaria romijni*	Tentacled lagoon-worm
3.2	*Amphianthus dohrnii*	Sea-fan anemone
3.3	*Arachnanthus sarsi*	Burrowing Sea Anemone
3.4	*Arctica islandica*	Ocean quahog
3.5	*Armandia cirrhosa*	Lagoon sandworm
3.21	*Atrina fragilis*	Fan mussel
3.6	*Eunicella verrucosa*	Pink sea-fan
3.7	*Gammarus insensibilis*	Lagoon sand shrimp
3.8	*Gobius cobitis*	Giant goby
3.9	*Gobius couchi*	Couch's goby
3.10	*Hippocampus guttulatus*	Long snouted seahorse
3.11	*Hippocampus hippocampus*	Short snouted seahorse
3.12	*Leptopsammia pruvoti*	Sunset cup coral
3.13	*Lithothamnion corallioides*	Coral maërl
3.14	*Nematostella vectensis*	Starlet sea anemone
3.15	*Ostrea edulis*	Native oyster
3.16	*Palinurus elephas*	Spiny lobster
3.17	*Paludinella littorina*	Sea snail
3.18	*Phymatolithon calcareum*	Common maërl
3.19	*Tenellia adspersa*	Lagoon sea slug
3.20	*Victorella pavida*	Trembling sea mat

2.1	Blue mussel beds: MLR_MytFves
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Most species within the biotope are widely distributed to the north or south of the British Isles and Ireland and unlikely to be adversely affected by long term changes in temperature at the benchmark level. Low to mid shore turf forming red algae (e.g. *Mastocarpus stellatus*, *Palmaria palmate* and *Osmundea pinnatifida*) were damaged or died at their upper limit during the exceptionally hot summer of 1983 (Hawkins & Hartnoll, 1985). Therefore, their abundance or upper limits may be reduced by short term increases in temperature at the benchmark level. Similarly, an acute temperature change (e.g. 5°C) will probably interfere with feeding activity in *Nucella lapillus* and in summer may result in direct mortality or indirect mortality due to heat coma and desiccation (see MarLIN review). Bousfield (1973) reported that amphipod tolerance to extremes of temperature was low. However, they probably derive protection within the macro algal fronds or mussel matrix. Ephemeral algae become more abundant in summer months and may be stimulated by increases in temperature. In the British Isles an upper, sustained thermal tolerance limit of about 29°C was reported in *Mytilus edulis* (Read & Cumming, 1967; Almada-Villla *et al.*, 1982). However, Seed & Suchanek (1992) noted that European populations were unlikely to experience temperatures greater than about 25°C. *Mytilus edulis* is generally considered to be eurythermal. *Fucus vesiculosus* can also withstand a wide range of temperatures and has been found to tolerate temperatures as high as 30°C (Lüning, 1990). The species is well within its temperature range in the British Isles so would not be affected by a change of 5°C. The species showed no sign of damage during the extremely hot summer of 1983, when the average temperature was 8°C hotter than normal (Hawkins & Hartnoll, 1985). Overall, the dominant characterizing species will probably survive an increase in temperature at the benchmark level, while some red algae may be reduced in abundance and species richness may suffer a minor decline. An increase in temperature is likely to decrease the threat of dog whelk predation. Therefore an intolerance of low has been recorded.
Temperature changes - local decrease	The dominant characterizing species are widely distributed to the north or south of Britain and Ireland. *Mytilus edulis* can withstand extreme cold and freezing, surviving when its tissue temperature drops to -10°C (Williams, 1970; Seed & Suchanek, 1992) or exposed to -30°C for as long as six hours twice a day (Loomis, 1995). Bourget (1983) also reported that cyclic exposure to otherwise sublethal temperatures, e.g. -8°C every 12.4 hrs resulted in significant damage and death after 3-4 cycles. This suggests that *Mytilus edulis* can survive occasional, sharp frost events, but may succumb to consistent very low temperatures over a few days. *Mytilus edulis* was relatively little affected by the severe winter of 1962/63, with 30% mortality reported from south-east coasts of England (Whitstable area) and ca. 2% from Rhosilli in south Wales (Crisp,1964) mainly due to predation on individuals weakened or moribund due to the low temperatures rather than the temperature itself. Overall, *Mytilus edulis* is considered to be eurythermal. *Fucus vesiculosus*, and *Littorina littorea* can withstand a wide range of temperatures. For example, *Fucus vesiculosus* was reported to tolerate -30°C in Maine (Lüning, 1990). *Nucella lapillus* can probably survive temperatures as low as 3°C and possibly 0°C, although

	evidence for duration is lacking, the effects of low temperatures being sub-vital (see MarLIN reviews). Bousfield (1973) reported that amphipod tolerance to extremes of temperature is low but they probably derive protection within the macroalgal fronds or mussel matrix. Overall, the dominant characterizing species will probably survive short term acute or long term chronic decreases in temperature at the bench mark level, while some mobile species may be lost by migration, reducing species richness. Therefore, an intolerance of low has been recorded to represent sublethal effects on growth and reproduction.
Salinity changes - local increase	This biotope occurs in full salinity and is unlikely to experience an increase in salinity, save due to short term evaporation of interstitial water.
Water flow (tidal current) changes - local increase	The biotope is found in wave exposed conditions where water movement from wave action will greatly exceed the strength of any possible tidal flow. The biotope is therefore considered to be not sensitive.
Water flow (tidal current) changes - local decrease	The biotope is characteristic of wave exposed conditions where water movement from wave action will greatly exceed the effects of any reduction of tidal flow. If the biotope occurred in areas where water flow was more important to provide an adequate supply of food and prevent siltation some adverse effects on feeding and reproduction may occur. Therefore an intolerance of low has been recorded.
Emergence regime changes - local increase	*Mytilus edulis* can only feed when immersed, therefore, changes in emergence regime will affect individuals ability to feed and their energy metabolism. Growth rates decrease with increasing shore height and tidal exposure, due to reduced time available for feeding and reduced food availability, although longevity increases (Seed & Suchanek, 1992; Holt *et al.*, 1998). Increased emergence will expose mussel populations to increased risk of desiccation (see above) and increased vulnerability to extreme temperatures, potentially reducing their upper limit on the shore, and reducing their extent in the intertidal. Therefore, the upper limit of the biotope and its associated community will probably decrease, being replaced by barnacles, and an intolerance of intermediate has been recorded. Recoverability will probably be high (see additional information below).
Emergence regime changes - local decrease	A decrease in emergence will reduce exposure to desiccation and extremes of temperature and allow the resident *Mytilus edulis* to feed for longer periods and hence grow faster. Therefore, the biotope will probably be able to colonize further up the shore into depressions or gaps in the barnacle cover. However, the lower limit of the biotope may become susceptible to greater predation pressure from crabs and/or dog whelks, resulting in greater turnover of individuals and a reduced number of size classes, and reduced age of mussels. In addition, the *Fucus vesiculosus* may be lost at its lower limit, replaced by patchy *Fucus serratus* and an increased abundance of red algae. Therefore, in the short term, a decrease in emergence is likely to change the population structure of the mussel bed at its lower limit, probably reducing the species richness of the mussel matrix, and the replacement of the lower limit of the biotope by another mussel dominated biotope e.g. MLR. MytFR. Although the mussel beds will effectively survive, the lower limit of the biotope as described will be lost and an intolerance of intermediate has been recorded. This biotope (MLR.MytFves) will probably colonize further up the shore and recovery will be rapid (see additional information below).

Wave exposure changes - local increase	This biotope occurs in moderately wave exposed and exposed shores. Mussels are tolerant of wave action, replacing fucoids and barnacles with increasing wave exposure and increase their byssus thread production (and hence attachment) with increased by water agitation (Young, 1985). However, Young (1985) suggested that mussels would be susceptible to sudden squalls and surges. Fouling organisms, e.g. barnacles and seaweeds, may also increase mussel mortality by increasing weight and drag, resulting in an increased risk of removal by wave action and tidal scour (Suchanek, 1985; Seed & Suchanek, 1992). Winter storms and increased wave exposure are likely to result in removal of patches of mussels, especially where hummocks form, creating gaps in the bed. However, with increasing wave exposure, the fucoids are likely to be lost, replaced by exposure tolerant algae such as *Porphyra*. The mussel bed is likely to become more patchy and dynamic with cycles of losses of mussels and recovery perhaps resembling ELR.MytB. Once formed gaps may be enlarged by wave action. In *Mytilus californianus* gaps were enlarged during winter, while recolonization and recovery rates increased in summer (Seed & Suchanek, 1992). A reduction in macroalgae will result in loss of associated mesoherbivores. Similarly, mobile gastropods such as top shells and littorinids are likely to be lost. Overall, an increase in wave exposure is likely to result in patchier mussel beds interspersed by barnacles, few fucoids and red algae at the lower limit of the biotope, similar to ELR.MytB. Although the mussel bed will probably survive, the biotope as described will be lost and probably replaced by a mussel and barnacle biotope characteristic of more wave exposed shores. Therefore, an intolerance of high has been recorded. Recoverability will probably be moderate (see additional information below).
Wave exposure changes - local decrease	A decrease in wave exposure from e.g. moderately exposed to very sheltered will have marked effects on the biotope. While many of the species present are tolerant of sheltered conditions, including *Mytilus edulis*, this biotope is likely to become replaced by fucoid dominated communities. Therefore, an intolerance of high has been recorded. Once conditions return to their prior state recoverability is likely to be moderate (see additional information below).
Water clarity increase	Decreased turbidity may increase phytoplankton primary productivity, therefore potentially increasing the food available to *Mytilus edulis* and other suspension feeders. Macroalgae may benefit from decreased turbidity resulting in rapid growth, especially of ephemeral green algae. Increased algal growth may destabilize the bed by increasing drag and smothering the mussels, although, grazers will probably compensate for the increased growth. Therefore, an intolerance of low has been recorded.
Water clarity decrease	Increased turbidity may reduce phytoplankton primary productivity, therefore reducing the food available to *Mytilus edulis* and other suspension feeders. However, mussels use a variety of food sources and the effects are likely to be minimal, and this species is probably not sensitive to changes in turbidity. Increased turbidity will decrease photosynthesis and primary productivity in seaweeds when immersed but they will probably be able to compensate when emersed. For example, *Fucus vesiculosus* occurs in the intertidal in turbid estuaries and red algae are regarded as shade tolerant. Therefore an intolerance of low has been recorded.

Non-synthetic compound contamination (incl. heavy metals)	Heavy metal contamination affects different taxonomic groups and species to varying degrees. The effects of contaminants on *Mytilus edulis* species were extensively reviewed by Widdows & Donkin, (1992) and Livingstone & Pipe (1992), and summarised in the MarLIN review. Heavy metals were reported to cause suble thal effects and occasionally mortalities in mixed effluents. Bryan (1984) suggested that adult gastropod molluscs (e.g. *Littorina littorea* and *Nucella lapillus*) were relatively tolerant of heavy metal pollution. Crustaceans are generally regarded to be intolerant of cadmium (McLusky *et al.*, 1986). In laboratory investigations Hong & Reish (1987) observed 96 hour LC50 of between 0.19 and 1.83 mg/l in the water column for several species of amphipod. Bryan (1984) suggested that the general order for heavy metal toxicity in seaweeds is: Organic Hg > inorganic Hg > Cu > Ag > Zn > Cd > Pb. Cole *et al.* (1999) reported that Hg was very toxic to macrophytes. However, it is generally accepted that adult fucoid are relatively tolerant of heavy metal pollution (Holt *et al.*, 1997). Overall, a proportion of the mussel bed and some intolerant species such as amphipods may be lost. An increase in fucoid abundance due to loss of mesoherbivores may also result in an increased vulnerability to wave related damage (see wave exposure above). Therefore, an intolerance of intermediate has been recorded. Recoverability will probably be high (see additional information below).
Non-synthetic compound contamination (incl. hydrocarbons)	Hydrocarbon contamination, e.g. from spills of fresh crude oil or petroleum products, may cause significant loss of component species in the biotope, through impacts on individual species viability or mortality, and resultant effects on the structure of the community. The effects of contaminants on *Mytilus edulis* species were extensively reviewed by Widdows & Donkin, (1992) and Livingstone & Pipe (1992), and summarised in the MarLIN review and Holt *et al.* (1998). Overall, hydrocarbon tissue burden results in decreased scope for growth and in some circumstances may result in mortalities, reduced abundance or extent of *Mytilus edulis* (see review). *Fucus vesiculosus* shows limited intolerance to oil. After the Amoco Cadiz oil spill *Fucus vesiculosus* suffered very little (Floc'h & Diouris, 1980). Indeed, *Fucus vesiculosus*, may increase significantly in abundance on a shore where grazing gastropods have been killed by oil, although very heavy fouling could reduce light available for photosynthesis and in Norway a heavy oil spill reduced fucoid cover. Littoral barnacles (e.g. *Semibalanus balanoides*) have a high resistance to oil (Holt *et al.*, 1995) but may suffer some mortality due to the smothering effects of thick oil (Smith, 1968). Gastropods (e.g. *Littorina littorea* and *Patella vulgata*) and especially amphipods have been shown to be particularly intolerant of hydrocarbon and oil contamination (see Suchanek, 1993). The abundance of littorinids decreased after the Esso Bernica oil spill in Sullom Voe in December 1978 (Moore *et al.*, 1995). The abundance of *Patella* sp., *Littorina saxatilis*, *Littorina littorea* and *Littorina neglecta* and *Littorina obtusata* were reduced but had returned to pre-spill levels by May 1979. In heavily impacted sites, subjected to clean-up, where communities were destroyed in the process, *Littorina saxatilis* recovered an abundance similar to pre-spill levels within ca 1 year, while *Littorina littorea* took ca 7 years to recover prior abundance (Moore *et al.*, 1995). Widdows *et al.* (1981) found *Littorina littorea* surviving in a rockpool, exposed to chronic hydrocarbon contamination due to the presence of oil from the Esso Bernica oil spill. Laboratory studies of the effects of oil and dispersants on several red algae species (Grandy 1984 cited in Holt *et al.* 1995) concluded that they were all intolerant of oil/ dispersant mixtures, with little differences between adults, sporelings, diploid or haploid life stages.

	O'Brien & Dixon (1976) suggested that red algae were the most sensitive group of algae to oil or dispersant contamination. Loss of grazing gastropods and mesoherbivores after oil spills results in marked increases in the abundance of ephemeral green algae (e.g. *Ulva* spp.) and fucoids (Southward & Southward, 1978; Hawkins & Southward, 1992; Raffaelli & Hawkins, 1999). As a result, surviving mussels may be smothered by macroalgae and subsequently lost due to wave action. The mussels may succumb directly to smothering by oil which is likely to be retained within the mussel matrix resulting in additional mortality to interstitial and infauna species. Although a proportion of the mussel population may survive hydrocarbon contamination, the additional effects on the community and potential for smothering suggest that the biotope will be lost. Therefore, an intolerance of high has been recorded. On wave exposed rocky coasts oil will be removed relatively quickly. Recovery of rocky shore populations was intensively studied after the Torrey Canyon oil spill in March 1967. Loss of grazers results in an initial flush of ephemeral green then fucoid algae, followed by recruitment by grazers including limpet, which free space for barnacle colonization (see recoverability for details). On shores that were not subject to clean up procedures, the community recovered within ca 3 years, however, in shores treated with dispersants recovery took 5-8 years but was estimated to take up to 15 years on the worst affected shores (Southward & Southward, 1978; Hawkins & Southward, 1992; Raffaelli & Hawkins, 1999). Recovery of the patches of mussels would probably depend on a reduction in macroalgal cover and recovery of the barnacle cover. Therefore, a recoverability of moderate has been recorded (see additional information below).
Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	The effects of contaminants on mussels, barnacles, limpets and fucoids have been particularly well studied. *Mytilus edulis* species were extensively reviewed by Widdows & Donkin, (1992) and Livingstone & Pipe (1992), and summarised in the MarLIN review and Holt *et al.* (1998). A variety of chemical contaminants have been shown to produce sublethal effects and reduce scope for growth (e.g. PCBs, and organo-chlorides) (Widdows *et al.*, 1995), while others (e.g. the detergent BP1002, the herbicide trifluralin and TBT) cause mortalities. Barnacles (e.g. *Semibalanus balanoides*) have a low resilience to chemicals such as dispersants, dependant on the concentration and type of chemical involved (Holt *et al.*, 1995). Limpets are extremely intolerant of aromatic solvent based dispersants used in oil spill clean-up (Smith, 1968; see MarLIN review of Patella vulgata for details). In addition, populations of dog whelk *Nucella lapillus* have been significantly reduced in areas subject to TBT population (see Bryan & Gibbs, 1991 and MarLIN review for discussion). Similarly, most pesticides and herbicides were suggested to be very toxic for invertebrates, especially crustaceans (amphipods, isopods, mysids, shrimp and crabs) and fish (Cole *et al.*, 1999). The pesticide ivermectin is very toxic to crustaceans, and has been found to be toxic towards some benthic infauna such as *Arenicola marina* (Cole *et al.*, 1999). Fucoids are generally quite robust in terms of chemical pollution but *Fucus vesiculosus* is extraordinarily highly intolerant of chlorate, as found in pulp mill effluents (Holt *et al.*, 1997). Laboratory studies of the effects of oil and dispersants on several red algae species (Grandy 1984 cited in Holt *et al.* 1995) concluded that they were all sensitive to oil dispersant mixtures, with little differences between adults, sporelings, diploid or haploid life stages. O'Brien & Dixon (1976) suggested that red algae were the most sensitive group of algae to oil or dispersant contamination. Overall, a number of chemical contaminants are likely to result in reduced growth and condition and loss of a proportion of the

	mussel population and hence the bed. Loss of intolerant dog whelks may be advantageous, especially at the lower limit of the mussel bed. Loss of intolerant epifaunal and epifloral grazers such as gastropods, isopods and amphipods may result in an increase in fouling of the mussels themselves by fucoids in particular resulting in increased loss due to wave action. Therefore a proportion of the mussel bed will be lost, while the species richness may show a marked decline, an intolerance of intermediate has been recorded. Recoverability is probably high (see additional information below).
Radionuclide contamination	Insufficient information
De-oxygenation	*Mytilus edulis* and *Fucus vesiculosus* are considered to be tolerant of a wide range of salinity (see MarLIN reviews for details). Most of the characterizing species (e.g. *Littorina littorea*, *Semibalanus balanoides*, and *Patella vulgata*) are tolerant of variable salinity, although *Patella* is not tolerant of reduced salinity. The intertidal interstitial invertebrates and epifauna probably experience short term fluctuating salinities, with increased salinity due to evaporation or reduced salinities due to rainfall and freshwater runoff when emersed. Prolonged reduction in salinity, e.g. from full to reduced is likely to adversely affect species richness of the biotope. While the dominant species will probably survive, the species richness of the biotope will be reduced due to loss of less tolerant red algae and some intolerant invertebrates. Areas of freshwater runoff in the intertidal promote the growth of ephemeral greens, probably due to their tolerance of low salinities and inhibition of grazing invertebrates. Therefore, an intolerance of intermediate has been recorded, together with a decline in species richness. Recoverability is likely to be high (see additional information below).
Nutrient enrichment	Nutrient enrichment may lead to an increase in algal growth but also leads to eutrophication and associated increases in turbidity and suspended sediments (see above), deoxygenation (see below) and the risk of algal blooms. Increased nutrient may increase growth in fast growing species (e.g. *Ulva* spp. and *Ulva lactuca*) to the detriment of slower growing species of macroalgae. However, *Fucus vesiculosus* was observed to grow in the vicinity of a sewage outfall (Holt *et al.*, 1997) and is probably not sensitive. An increase in ephemeral algae may be detrimental to the mussel bed due to smothering of the mussels. *Mytilus edulis* may benefit from moderate nutrient enrichment, especially in the form of organic particulates and dissolved organic material. The resultant increased food availability may increase growth rates, reproductive potential and decrease vulnerability to predators. Mussels are suspension feeders and accumulate toxins from toxic algae resulting in closure of shellfish beds (Shumway, 1992). The toxic algal blooms themselves (or deoxygenation resulting from their death) have been shown to cause tumours, sublethal effects, reproductive failure and to be highly toxic to *Mytilus edulis*, and result in mass mortalities in the dog whelk *Nucella lapillus* (Pieters *et al.*, 1980; Shumway, 1990; Landsberg, 1996; Holt *et al.*, 1998; Gibbs *et al.*, 1999). Therefore, algal blooms may result in loss of a proportion of the biotope and its associated species and an intolerance of intermediate has been recorded. Recoverability is probably high (see additional information).
Habitat structure changes - removal of	Removal of the substratum will include the removal of all the species within the biotope. Therefore, an intolerance of high has been recorded. Although a single good recruitment event may recolonize the substratum within a year, recovery may take up to 5 years, and is some circumstances

substratum (extraction)	significantly longer (see additional information below). Therefore, a recoverability of moderate has been recorded.
Heavy abrasion, primarily at the seabed surface	Daly & Mathieson (1977) reported that the lower limit of *Mytilus edulis* populations at Bound Rock, USA, was determined by burial or abrasion by shifting sands. Wave driven logs have been reported to influence *Mytilus edulis* populations, causing the removal of patches from extensive beds that subsequently open the beds to further damage by wave action. It is likely that abrasion or impact at the level of the benchmark would also damage or remove patches of the population. The effects of trampling on *Mytilus californianus* beds in Australia were studied by Brosnan & Cumrine (1994). They concluded that mussel beds were intolerant of trampling, depending on bed thickness, and noted that in heavily tramped site mussels were uncommon and restricted to crevices. Trampling also inhibited subsequent recovery. Trampling pressure was most intense in spring and summer, so that gaps and patches created by storms in winter were not repaired but exacerbated. Fucoid cover has also been reported to be reduced by trampling (Holt *et al.*, 1997). Brosnan & Cumrine (1994) also observed that barnacles were crushed and removed by trampling in California but recovery took place within one year following the cessation of trampling. Therefore, it is likely that abrasion and physical disturbance at the benchmark level will result in loss of a proportion of the mussel patches, fucoids and their associated species and an intolerance of intermediate has been recorded. Recoverability is likely to be high (see additional information below). Large scale abrasion e.g. due to a vessel grounding, is likely to be similar to substratum loss in effect.
Light abrasion at the surface only	
Siltation rate changes	Intertidal *Mytilus edulis* beds have been reported to suffer mortalities as a result on smothering by large scale movements of sand or sand scour (Holt *et al.*, 1998; Daly & Mathieson, 1977). Similarly, biodeposition within a mussel bed results in suffocation or starvation of individuals that cannot re-surface. Young mussels have been shown to move up through a bed, avoiding smothering, while many others were suffocated (Dare, 1976; Holt *et al.*, 1998). This suggests that a proportion of the *Mytilus edulis* population may be able to avoid smothering. Gastropods (e.g. *Littorina littorea*) may be suffocated by the sediment. Smothering may also adversely affect interstitial fauna and epifauna, resulting in a decrease in species richness and an increase of infaunal species (Tsuchiya & Nishihira, 1985, 1986). However, on moderately wave exposed to exposed coasts sediment is unlikely to remain in place resulting in scour which may remove a proportion of the mussels and probably adversely affect *Fucus vesiculosus* and other macroalgae. After one month (see benchmark) although fronds may have been removed or died back, a proportion of holdfasts and hence plants would probably survive to grow back. Therefore, an overall intolerance of intermediate has been recorded. Smothering by impermeable or immobile materials, e.g. oil may result in a higher intolerance (see hydrocarbons). Recoverability has been recorded as moderate (see additional information below).

	Mytilus edulis has been reported to be relatively tolerant of suspended sediment and siltation and survived over 25 days at 440 mg/l and on average 13 days at 1200mg/l (Purchon, 1937; Moore, 1977). *Mytilus edulis* also has efficient pseudofaeces discharge mechanisms (Moore, 1977; de Vooys, 1987), although increased suspended sediment may reduce feeding efficiency (Widdows *et al.*, 1998). The gastropods and amphipods within the biotope occur in more sheltered habitats and are probably tolerant of a range of suspended sediment levels. Increased siltation will probably interfere with larval recruitment in some species, e.g. macroalgae. *Fucus vesiculosus* may suffer as a result of increased scour (see above) and the associated turbidity will reduce photosynthesis (see below), but occurs in more sheltered environments and estuaries and is probably tolerant of siltation. Increased siltation may fill the mussel matrix, resulting in increase infauna but loss of more mobile species and species richness (Tsuchiya & Nishihira, 1985, 1986). Overall, the biotope will be little affected but species richness will probably decline and an intolerance of low has been recorded.
	A decrease in suspended sediment, especially organic particulates could potentially reduce the food available to *Mytilus edulis* and the other suspension feeders within the biotope. However, little other effects are likely. Therefore, an intolerance of low has been recorded.
Underwater noise changes	*Mytilus edulis* can probably detect changes in light commensurate with shading by predators. But its visual acuity is probably very limited and it is unlikely to be sensitive to visual disturbance. Birds are highly intolerant of visual presence and are likely to be scared away by increased human activity, therefore reducing the predation pressure on the mussels. Therefore, visual disturbance may be of indirect benefit to mussel populations.
Visual disturbance	*Mytilus edulis* can probably detect changes in light commensurate with shading by predators. But its visual acuity is probably very limited and it is unlikely to be sensitive to visual disturbance. Birds are highly intolerant of visual presence and are likely to be scared away by increased human activity, therefore reducing the predation pressure on the mussels. Therefore, visual disturbance may be of indirect benefit to mussel populations.
Introduction or spread of non-indigenous species.	Information of the effects of diseases or parasites in all characterizing species in the community was not available. *Mytilus* spp. hosts a wide variety of disease organisms, parasites and commensally from many animal and plant groups including bacteria, blue green algae, protozoa, boring sponges, boring polychaetes, boring lichen, the intermediary life stages of several trematodes, the copepod *Mytilicola intestinalis* (red worm disease) and decapods e.g. the pea crab *Pinnotheres pisum* (Bower, 1992; Bower & McGladdery, 1996). Bower (1992) noted that mortality from parasitic infestation in *Mytilus* sp. was lower than in other shellfish in which the same parasites or diseases occurred. Mortality may result from the shell boring species such as the polychaete *Polydora ciliata* or sponge *Cliona celata*, which weaken the shell increasing the mussels vulnerability to predation (see MarLIN review for details). Barnacles are parasitised by a variety of organisms and, in particular, the cryptoniscid isopod *Hemioniscus balani*, in which heavy infestation can cause castration of the barnacle. Intertidal gastropods often act a secondary hosts for trematode parasites of sea birds. For example, *Nucella lapillus* may be infected by cercaria larvae of the trematode *Parorchis acanthus*. Infestation causes castration and continued growth (Feare, 1970b; Kinne, 1980; Crothers,

	1985). Overall, the occurrence of diseases and parasites are probably highly variable but significant infestations may result in loss of the proportion of the mussel bed and important members of the community, either through mortality or reproductive failure. Therefore, an intolerance of intermediate has been recorded. Recovery is likely to be high (see additional information below).
Introduction of microbial pathogens	In moderately wave exposed to exposed habitats the resultant water movement and turbulence probably provides adequate oxygenation so that deoxygenation at the benchmark is unlikely to occur except under extreme circumstances.
Removal of target habitat	The most significant non-native species currently likely to occur in this biotope is the barnacle *Elminius modestus*, which may replace *Semibalanus balanoides* in estuaries but is less competitive on exposed coasts (Raffaelli & Hawkins, 1996). The South American mytilid *Aulocomya ater* was reported recently in the Moray Firth, Scotland in 1994 and again in 1997 (McKay, 1994; Holt *et al.*, 1998; Eno *et al.*, 1997). *Aulocomya ater* is thought to have a stronger byssal attachment than *Mytilus edulis* and may replace *Mytilus edulis* in more exposed areas if it reproduces successfully (Holt *et al.*, 1998). However, there is no evidence of competition at present. Overall, there is little evidence of this biotope being adversely affected by non-native species.
Removal of non-target habitat	The only regularly harvested species to occur in this biotope are *Mytilus edulis* and *Littorina littorea*. Holt *et al.*, (1998) suggest that when collected by hand at moderate levels using traditional skills mussel beds will probably retain most of their biodiversity. They also cite incidences of over-exploitation of easily accessible small beds by anglers for bait. Holt *et al.*, (1998) suggest that in particular embayments over-exploitation may reduce subsequent recruitment leading to long term reduction in the population or stock. The edible winkle *Littorina littorea* is harvested by hand, without regulation, for human consumption. In some areas, notably Ireland, collectors have noted a reduction in the number of large snails available (see MarLIN review). Fucoids may be harvested by hand locally, but the abundance in this biotope is low and unlikely to attract commercial harvesting. Overall, removal of 50% of the key or important characterizing species (see benchmark) is likely to result in a reduction of the extent of the mussel bed and its associated species, and an intolerance of intermediate has been recorded. Prolonged un-regulated collection may result in loss of the bed e.g. a small bed close to a road on Anglesey was almost eliminated by anglers and bait diggers over a period of years (Holt *et al.*, 1998). Recoverability is likely to be high.

2.1	**Blue mussel beds IMX_Mytv**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Sublittoral populations are unlikely to experience rapid or extreme temperature changes due to natural events and may, therefore, be expected to be intolerant of acute temperature change. An upper, sustained temperature tolerance limit of about 29°C has been reported for *Mytilus edulis* in the United Kingdom (Read & Cumming, 1967; Almada-Villa et al., 1982). Seed & Suchanek (1992) noted that European populations were unlikely to experience temperatures greater than 25° C. Therefore, *Mytilus edulis* was consider to be of low intolerance to temperature change. *Nucella lapillus* may succumb to increased temperatures in summer but is otherwise relatively tolerant. *Balanus crenatus* and *Asterias rubens*, however, were assessed as highly intolerant of increased temperatures. Overall, the biotope has been assessed as of low intolerance to increased temperatures since the key species, *Mytilus edulis*, is unlikely to be adversely affected. Recovery is likely to be rapid (see additional information below).
Temperature changes - local decrease	Sublittoral populations are unlikely to experience rapid or extreme temperature changes due to natural events and may, therefore, be expected to be intolerant of acute temperature change. However, *Mytilus edulis* tolerates decreases in temperature and even freezing for short periods. *Mytilus edulis* was relatively little affected by the severe winter of 1962/63, with 30% mortality reported from south-east coasts of England (Whitstable area) and ca. 2% from Rhosilli in south Wales (Crisp (ed.),1964). Similarly, the barnacle *Balanus crenatus*, were unaffected by the severe winter of 1962/63 (Crisp, 1964). Most of the polychaetes characterizing the biotope have a wide distribution and are probably tolerant of low temperatures, especially when protected from temperature change by their infaunal habit. It appears, therefore, that most of the characterizing species within the biotope are tolerant of an acute short term temperature decrease and a biotope intolerance of low has been recorded. Recovery is likely to be rapid (see additional information below).
Salinity changes - local increase	*Mytilus edulis* is considered to be tolerant of a wide range of salinities. Many members of the community occur in the intertidal and estuaries, exposed to fluctuating salinities. An increase from reduced to full salinity is likely to result in a change in species composition, to include more fully marine species and increased species richness, while the mussel bed itself is likely to be little affected. Since the biotope is likely to be persist and species richness increase, not sensitive* has been recorded.

Water flow (tidal current) changes - local increase	As mussel beds increase in size and depth, individual mussels become increasingly attached to each other rather than the substratum. As a result, the bed may become destabilised and susceptible to removal by wave action or tidal scour. However, mussels at the edge of the beds are often more strongly attached than mussels within the bed (Seed & Suchanek, 1992). On sedimentary shores, mussel beds are probably intolerant of increased water flow due to removal of the sediment resulting in loss of clumps of the bed. Mussel reefs in the Wash, Morecambe Bay and the Wadden Sea are vulnerable to destruction by storms and tidal surges (Holt *et al.*, 1998). Therefore, a change in water flow rate from weak to strong (the benchmark) would probably result in the loss of clumps or large parts of the mussel bed, Loss of the bed would result in loss of the epifaunal and predatory species associated with them, together with the interstitial fauna and a proportion of the benthic infauna. Therefore, an intolerance of high has been recorded. Although a single good recruitment event may recolonize the substratum within a year, recovery may take up to 5 years, and is some circumstances significantly longer (see additional information below). Therefore, a recoverability of high has been recorded.
Water flow (tidal current) changes - local decrease	This biotope is found in moderately strong to weak tidal streams and further reduction in water flow may result in an increased sedimentation (see above) and risk of low oxygen conditions (see below). The mussels, and other suspension feeders, probably require water flow to supply food (suspended particulates, benthic diatoms and phytoplankton). However, overall a reduction in water flow is likely to have only limited affects and an intolerance of low and a recoverability of very high has been recorded.
Emergence regime changes - local increase	An increase in emergence will effectively move the upper limits of the biotope into the lower intertidal. *Mytilus edulis* can form extensive beds in the intertidal. Growth rates will decrease due to loss of feeding time at low tide. However, the major predators will probably change, from the starfish and crabs of the sublittoral to birds and wildfowl in the eulittoral. Dog whelk predation will probably remain about constant, while fish predation will be limited to high tides. Most of the epifauna and infaunal polychaetes and amphipods are recorded from the lower shore and likely to be little affected. However, wildfowl predation may be significant, and is likely to change to size and age distribution within the bed and disrupt the mussel bed itself, e.g. eider duck, therefore an intolerance of intermediate has been recorded. Recovery is likely to be rapid (see additional information).
Emergence regime changes - local decrease	An increase in tidal submergence is likely to allow the biotope to extend its range further up the shore. Therefore, a rank of not sensitive* has been recorded.

Wave exposure changes - local increase	The intolerance of mussel beds probably owes more to the nature of the substratum than the strength of their attachment. Individuals attached to solid sub strata (rock) are likely to be more tolerant than individuals attached to boulders, cobbles or sediment. Harger & Landenberger (1971) noted that, on gravel based substratum, small, single layered mussel beds suffered far less damage from storms that heavy, multi-layered beds. As mussel beds grow in size and thickness relatively fewer mussels are directly attached to the substratum, so that heavy seas can "roll up the whole mass of mud and mussels like a carpet and break it to pieces on the foreshore" (Harger & Landenberger, 1971). Storms and tidal surges are known to destroy mussel beds, often over hundreds of hectares in the Wash, Morecambe Bay and the Wadden Sea. Mussels beds persist in sheltered areas whereas beds in exposed areas are more dynamic (Holt *et al.*, 1998). Greater water flow increases particle availability and keeps particles in suspension for a longer time, thereby increasing feeding time and feeding efficiency (Fréchette *et al.*, 1989). Mussel densities increased with increasing wave exposure. Mussel biomass is reported to be highest at areas with intermediate exposure. Higher water flow and particle delivery increase the carrying capacity of the shore, and habitats with high water flow generally maintain higher densities of suspension feeders (Westerbom & Jattu, 2006). Although subtidal beds are protected by depth, shallow sublittoral wave action may still be significant. An increase in wave action from sheltered to exposed (the benchmark) is likely to remove a large proportion of the bed, the remaining mussel mud and modify the average grain size of the sediment (from fine to coarse) resulting in major changes in the benthic infauna. Therefore an intolerance of high has been recorded. Recovery may take up to 5 years or longer once prior conditions return (see additional information below) and a recoverability of high has been recorded.
Wave exposure changes - local decrease	On wave sheltered sedimentary shores decreased wave exposure (i.e. sheltered to very sheltered) is likely to have little affect on mussel beds. Therefore, sheltered shore mussels beds are probably of low intolerance to decreased wave exposure, and may be less patchy and more stable (persistent). Reduced wave action will decrease water flow over the bed (see above) and may increase the risk of deoxygenation (see below).
Water clarity increase	This biotope is an animal dominated community, dependant on secondary production and not dependant on light. Therefore, the biotope is probably not sensitive to changes in turbidity and light attenuation.
Water clarity decrease	This biotope is an animal dominated community, dependant on secondary production and not dependant on light. Therefore, the biotope is probably not sensitive to changes in turbidity and light attenuation.
Nutrient enrichment	Moderate nutrient enrichment, especially in the form of organic particulates and dissolved organic material, is likely to increase food availability for all the suspension feeders within the biotope. Therefore, 'not sensitive*' has been recorded. However, long term or high levels of organic enrichment may result in deoxygenation and algal blooms. *Mytilus edulis* has been reported to suffer mortalities due to algal blooms of *Gyrodinium aureolum* and *Phaeocystis poucheri* (Holt *et al.*, 1998). *Nucella lapillus* has been shown to be severely affected by toxic algal blooms (see review; Robertson, 1991; Gibbs *et al.*, 1999). Death of toxic and non-toxic algal blooms may result in large numbers of dead algal cells collecting on the sea bottom, resulting in local de-oxygenation as the algal decompose. Although, *Mytilus edulis* is probably tolerant of anoxic conditions other members of the community may be more intolerant (see oxygenation

	below).
Habitat structure changes - removal of substratum (extraction)	Removal of the substratum will remove of all the species within the biotope. Therefore, an intolerance of high has been recorded. Although a single good recruitment event may recolonize the substratum within a year, recovery may take up to 5 years, and is some circumstances significantly longer (see additional information below). Therefore, a recoverability of high has been recorded.
Heavy abrasion, primarily at the seabed surface	Wave driven logs have been reported to influence *Mytilus edulis* populations, causing the removal of patches from extensive beds that subsequently open the beds to further damage by wave action (Holt *et al.*, 1998). A similar effect could be caused by a vessel grounding. Little information on physical disturbance in subtidal *Mytilus* spp. beds was found. Fishing activities, e.g. scallop dredging are know to physically disturb marine communities. *Modiolus modiolus* beds have been reported to have declined off the Isle of Man due to scallop dredging, presumably because the scallop dredging activity had damaged the edges of denser beds over time (Jones, 1951; Holt *et al.*, 1998). Benthic trawls, where they occur, may affect *Mytilus edulis* beds similarly. Of the other species in the biotope, starfish, such as *Asterias rubens*, have been reported to be damaged by benthic dredges but have considerable regenerative capability, and, as scavengers, benefit from the presence of other damaged or killed animals (Emson & Wilkie, 1980; Gubbay & Knapman, 1999). Therefore, it is likely that abrasion or impact at the level of the benchmark (a scallop dredge) would damage or remove patches of the population and an intolerance of intermediate has been recorded. Recovery is dependant on recruitment of *Mytilus edulis* and a recoverability of high has been reported (see additional information below).
Light abrasion at the surface only	
Siltation rate changes	Intertidal *Mytilus edulis* beds have been reported to suffer moralities as a result on smothering by large scale movements of sand or sand scour (Holt *et al.*, 1998; Daly & Mathieson, 1977). Similarly, biodeposition within a mussel bed results in suffocation or starvation of individuals that cannot re-surface. Young mussels have been shown to move up through a bed, avoiding smothering, while many others were suffocated (Dare, 1976; Holt *et al.*, 1998). This suggests that a proportion of the population may be able to avoid smothering in subtidal conditions, and, therefore, an intolerance of intermediate has been recorded. Many infaunal species are likely to be not sensitive to smothering by the same grade of sediment, however, interstitial species and epifauna may be adversely affected. Although a single good recruitment event may recolonize the substratum within a year, recovery may take up to 5 years, and is some circumstances significantly longer (see additional information below). Therefore, a recoverability of high has been recorded.

	Mytilus edulis has been reported to be relatively tolerant of suspended sediment and siltation and survived over 25 days at 440mg/l and on average 13 days at 1200mg/l (Purchon, 1937; Moore, 1977a). *Mytilus edulis* also has efficient pseudofaeces discharge mechanisms (Moore, 1977a; de Vooys, 1987). *Asterias rubens* flourishes in naturally turbid conditions and is capable of cleansing itself of adherent mud particles (Moore, 1977). *Nucella lapillus* is also found in turbid environments such as the Bristol Channel. Similarly, the barnacle *Balanus crenatus* was considered to be of low intolerance to suspended sediment. However, these species probably suffer a metabolic cost resulting from the cleansing mechanisms, mucus production and interrupted or impaired feeding. Therefore, a biotope intolerance of low, at the benchmark level, has been recorded. The majority of the organisms within the biotope are adapted to sedimentary, estuarine habitats and probably have mechanisms to deal with siltation and suspended sediment, so that recoverability of immediate has been recorded.
	A decrease in suspended sediment, especially organic particulate could potentially reduce the food available to *Mytilus edulis* and the other suspension feeders within the biotope. A reduction in sedimentation could potential result in increased rates of erosion in sedimentary habitats. However, a large proportion of deposition within the mussel bed is due to accumulation of faeces and pseudofaeces. Therefore, a decrease in sedimentation at the benchmark level is probably not significant and an intolerance of low has been recorded.
Underwater noise changes	*Mytilus edulis* and most invertebrate species within the biotope are probably insensitive to noise disturbance at the levels of the benchmark.
Visual disturbance	*Mytilus edulis* and most invertebrate species within the biotope are probably insensitive to visual disturbance at the levels of the benchmark.
Introduction or spread of non-indigenous species.	The diseases and parasites of *Mytilus edulis* were reviewed by Bower (1992) and Bower & McGladdery (1996) (see the species review). The boring sponge *Cliona* spp. has been reported from *Modiolus modiolus* beds and may affect subtidal *Mytilus edulis* beds. Similarly, subtidal beds may be affected by the boring polychaete *Polydora ciliata*. Both of the above boring species weaken the shell of the victim and makes them more vulnerable to predation. *Polydora ciliata* also causes blisters, atrophy of muscle tissue and interferes with gamete production and has resulted in substantial mortalities in European mussel populations. *Asterias rubens* may be parasitised by the ciliate *Orchitophyra stellarum* (Vevers, 1951; Bouland & Clareboudt, 1994) resulting in castration of males, and subsequent reduction in population size (Vevers, 1951). *Nucella lapillus* may also suffer form castration due to infestation with the larval stages of sea bird trematode parasites. None of the above were reported to cause high mortalities so that the biotope would probably persist. Therefore, an intolerance of low and a recoverability of very high has been recorded (see additional information below).

Introduction of microbial pathogens	*Mytilus edulis* was regarded to be tolerant of a wide range of oxygen concentrations including zero (Zwaan de & Mathieu, 1992; Diaz & Rosenberg, 1995; see species review). Intolerance to hypoxia is variable. Echinoderms such as *Asterias rubens* are highly intolerant of anoxic conditions. Similarly, the barnacle *Balanus crenatus* was considered to be highly intolerant of anoxia (see review). Crustacea are probably intolerant of hypoxia but would be able to migrate to more suitable condition. However, most polychaetes are capable of anaerobic respiration and *Capitella capitata*, *Hediste diversicolor* and *Scoloplos armiger* were considered to be resistant of moderate hypoxia while *Nephtys hombergii* and *Heteromastus filiformis* were thought to be resistant of severe hypoxia (Diaz & Rosenberg, 1995). Therefore, *Mytilus edulis* is likely to tolerate hypoxic conditions. However, hypoxia is likely to cause species specific mortality and reduce species richness, an intolerance of intermediate. Recoverability of the associated species is likely to be rapid (see additional information below).
Removal of target habitat	*Mytilus edulis* is an effective space occupier and few other species are able to out-compete it for space. However, the South American mytilid *Aulocomya ater* has been reported recently in the Moray Firth, Scotland in 1994 and again in 1997 (McKay, 1994; Holt *et al.*, 1998; Eno *et al.*, 2000). *Aulocomya ater* is thought to have a stronger byssal attachment than *Mytilus edulis* and may replace *Mytilus edulis* in more exposed areas if it reproduces successfully (Holt *et al.*, 1998). However, its potential effects in sheltered sedimentary habitats are unknown.
Removal of non-target habitat	Large mussel beds in the intertidal and subtidal have been routinely fished for hundreds of years, and managed by local Sea Fishery Committees in England and Wales for the past hundred years (Holt *et al.*, 1998). Subtidal mussel beds may be exploited by dredging. Holt *et al.*, (1998) suggest that, in particular embayments, over-exploitation may reduce subsequent recruitment leading to long term reduction in the population or stock. The relationship between stock and recruitment is poorly understood. Loss of stock may have significant effects on other species, e.g. in the Dutch Wadden Sea in 1990 the mussel stocks fell to unprecedented low levels resulting in death or migration of eiders, and oystercatchers seeking alternative prey such as *Cerastoderma edule*, *Mya arenaria*, and *Macoma baltica*. Extraction of *Mytilus edulis* is likely to remove much of the epifaunal and infaunal community, resulting in a decline in species richness. Overall, an intolerance of intermediate has been recorded at the benchmark level of extraction. However, recovery is likely to occur within 5 years and a recoverability of high has been recorded (see additional information below).

2.1	**Mussels MCR_MytHAs**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Circalittoral populations are unlikely to experience rapid or extreme temperature changes due to natural events and may, therefore, be expected to be intolerant of acute temperature change. However, an upper, sustained temperature tolerance limit of about 29°C has been reported for *Mytilus edulis* in the United Kingdom (Read & Cumming, 1967; Almada-Villa *et al.*, 1982). Seed & Suchanek (1992) noted that European populations were unlikely to experience temperatures greater than 25°C. Therefore, *Mytilus edulis* was considered to be of low intolerance to temperature change. Similarly, *Urticina felina* and *Alcyonium digitatum* were considered to be of low intolerance to temperature change. *Balanus crenatus* and *Asterias rubens* however, were assessed as highly intolerant of increased temperatures. Overall, the biotope has been assessed as of low intolerance to increased temperatures since the key species, *Mytilus edulis* is unlikely to be adversely affected. Recovery is likely to be rapid (see additional information below).
Temperature changes - local decrease	Circalittoral populations are unlikely to experience rapid or extreme temperature changes due to natural events and may, therefore, be expected to be intolerant of acute temperature change. However, *Mytilus edulis* tolerates decreases to in temperature and even freezing for short periods. Similarly, *Balanus crenatus*, *Alcyonium digitatum*, *Asterias rubens* and *Urticina felina* were unaffected by the severe winter of 1962/63 (Crisp, 1964). It appears, therefore, that most of the characterizing species within the biotope are tolerant of an acute short term temperature decrease and a biotope intolerance of low has been recorded. No information regarding the temperature tolerance of hydroids or bryozoans was found, and these groups may be more intolerant. Recovery is likely to be rapid (see additional information below).
Salinity changes - local increase	The biotope is sublittoral and present on the open coast in full salinity conditions. Increase in salinity is therefore considered not relevant.
Water flow (tidal current) changes - local increase	The strong tidal streams characteristic of this biotope probably supply the community with adequate food in the form of particulates. This is a particular importance for passive suspension feeders such as hydroids and bryozoans. An increase in water flow may dislodge a proportion of the *Mytilus edulis* bed and increase competition for space from species adapted to very strong water flow rates such as *Tubularia indivisa*. *Mytilus edulis* populations are found from weak to strong tidal streams, suggesting a low intolerance to water flow rates. Similarly, Young (1985) reported that *Mytilus edulis* increased byssus thread production in response to increased agitation and water flow rates, and that *Mytilus edulis* was able to withstand surges of up to 16 m/s. However, Young (1985) also noted that mussels would be susceptible to sudden squalls and surges. Predation by *Asterias rubens* may also be decreased by increased water flow rates or wave exposure (Hiscock, 1983). *Urticina felina* and *Alcyonium digitatum* prefer areas of strong water flow, and *Balanus crenatus* is found in a wide range of water flow regimes. Species such as *Molgula manhattensis* and *Flustra foliacea* thrive in strong water flow but are found at low abundance in very wave exposed and very strong tidal streams (Hiscock, 1983). However,

	overall an intolerance of low has been recorded. Recoverability is likely to be rapid.
Water flow (tidal current) changes - local decrease	The strong tidal streams characteristic of this biotope probably supply the community with adequate food in the form of particulates. This is a particular importance for passive suspension feeders such as hydroids and bryozoans. *Mytilus edulis* tolerates a wide range of water flow rates. However, decreases in water flow rates are likely to increase siltation (see above) and increase predation pressure from crabs, lobsters and starfish such as *Asterias rubens*. The biotope is likely to suffer from competition from species adapted to more sheltered conditions. Therefore, an intolerance of intermediate has been recorded. Although, *Mytilus edulis* is highly fecund, larval mortality is high. Larval development occurs within the plankton over ca 1 month (or more), therefore, whilst recruitment within the population is possible, it is likely that larval produced within the biotope are swept away from the biotope to settle elsewhere. Therefore, recovery is dependant on recruitment from outside the biotope and a recoverability of high has been reported (see additional information below).
Emergence regime changes - local increase	An increase or decrease in tidal emergence is unlikely to affect circalittoral habitats.
Emergence regime changes - local decrease	An increase or decrease in tidal emergence is unlikely to affect circalittoral habitats, except that the influence of wave action and tidal streams may be increased (see water flow rate below).
Wave exposure changes - local increase	Wave exposure causes oscillatory flow on the sea bed, the magnitude of which is attenuated with depth. Therefore, increases in wave exposure are likely to increase water flow rates in the circalittoral (see increases in water flow above). However, oscillatory water movement is potentially far more destructive than tidal streams due to the 'to and fro' motion is more likely to loosen mussels. Therefore, an intolerance of intermediate has been recorded. Although, *Mytilus edulis* is highly fecund, larval mortality is high. Larval development occurs within the plankton over ca 1 month (or more), therefore, whilst recruitment within the population is possible, it is likely that larval produced within the biotope are swept away from the biotope to settle elsewhere. Therefore, recovery is dependant on recruitment from outside the biotope and a recoverability of high has been reported (see additional information below).
Wave exposure changes - local decrease	Wave exposure causes oscillatory flow on the sea bed, the magnitude of which is attenuated with depth. Therefore, decreases in wave exposure are likely to decrease water flow rates in the circalittoral, depending on the prevalent tidal streams. See increases in water flow rates above.
Water clarity increase	Foliose algae have been reported in some records of this biotope (Hiscock, 1984). However, this biotope is primarily an animal dominated community, dependant on secondary production and not dependant on light. Therefore, the biotope is probably not sensitive to changes in turbidity and light attenuation.
Water clarity decrease	Foliose algae have been reported in some records of this biotope (Hiscock, 1984). However, this biotope is primarily an animal dominated community, dependant on secondary production and not dependant on light. Therefore, the biotope is probably not sensitive to changes in turbidity and light attenuation.

Non-synthetic compound contamination (incl. heavy metals)	Lethal threshold concentrations for several heavy metals have been determined in *Mytilus edulis* (see species review; Widdows & Donkin (1992) and Livingstone & Pipe (1992) for reviews). Mussels were also reported to be missing from a wider area of the Cumbrian coast than other organisms in the vicinity of a phosphate rich effluent contaminated by heavy metals (Holt *et al.*, 1998). Widdows & Donkin (1992) noted that lethal responses give a false impression of high tolerance. However, *Mytilus edulis* is probably relatively tolerant of heavy metal contamination. Besten *et al.* (1989) suggested that cadmium (Cd) pollution posed a significant threat to populations of *Asterias rubens* since it affected reproduction. Little information concerning heavy metal toxicity was found for hydroids, bryozoans and ascidians. Therefore, given the evidence of sub-lethal and lethal effects of heavy metals in *Mytilus edulis* a biotope intolerance of intermediate has been reported.
Non-synthetic compound contamination (incl. hydrocarbons)	The effects of contaminants on *Mytilus edulis* were extensively reviewed by Widdows & Donkin (1992) and Livingstone & Pipe (1992). Overall, *Mytilus edulis* is probably relatively tolerant of contaminants, although mortalities have been recorded (see species review for details). Circalittoral populations are protected from the immediate effects of oil spills by their depth. Therefore, hydrocarbon contamination in the circalittoral populations is limited to exposure to lighter oil fractions and PAHs in solution, as droplets as a result of wave exposure or adsorbed onto particulates. Toxic hydrocarbons and PAHs contribute to a decline on the scope for growth in *Mytilus edulis* (Widows & Donkin, 1992; Widdows *et al.*, 1995;). The presence of poly-aromatic hydrocarbons, cis-chlordane pesticides and cadmium has been associated with an increase in tumours in *Mytilus edulis* (Hillman, 1993; Holt *et al.*, 1998). Mesocosm experiments have shown high mortalities of *Mytilus edulis* exposed to the water accommodated fraction of diesel (Widdows *et al.*, 1987; Bokn *et al.*, 1993). Ingestion of droplets of sunflower oil, from a tanker spill off the Anglesey coast resulted in mortalities after spawning (Mudge *et al.*, 1993; Holt *et al.*, 1998). *Asterias rubens* suffered mass mortalities after the Torrey Canyon oil spill and was reported to be lost from mesocosms treated with the water accommodated fraction of diesel (Smith, 1968; Bokn *et al.*, 1993). *Mytilus edulis* dominated jetty piles immediately adjacent to an oil refinery effluent in Milford Haven, suggesting a high tolerance of hydrocarbon contamination (K. Hiscock, pers. comm.). Overall, *Mytilus edulis* is probably relatively tolerant of chronic hydrocarbon pollution. However, due to the incidence of mortality after exposure to diesel and oils *Mytilus edulis* was regarded as of intermediate intolerance to hydrocarbon contamination. Little information was found concerning the effects of hydrocarbon pollution on hydroids, bryozoans, or ascidians. Although, *Asterias rubens* has been assessed as highly intolerant, the mussel bed may benefit from a reduction in starfish predation, and an overall biotope intolerance of intermediate has been recorded. Recovery is probably dependant on *Mytilus edulis* recruitment and a recoverability of high has, therefore, been recorded (see additional information below).
Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	The effects of contaminants on *Mytilus edulis* were extensively reviewed by Widdows & Donkin (1992) and Livingstone & Pipe (1992). Overall, *Mytilus edulis* is probably relatively tolerant of contaminants, although mortalities have been recorded (see species review for details). For example, Widdows *et al.*, (1995) noted that polar organics, and organo-chlorines reduced scope for growth in *Mytilus edulis*; *Mytilus edulis* has been shown to accumulate PCBs and ivermecten (Hummel *et al.*, 1989; Cole *et al.*, 1999; Holt *et al.*, 1995); the presence of poly-aromatic hydrocarbons, cis-

	chlordane pesticides and cadmium gas been associated with an increase in tumours in *Mytilus edulis* (Hillman, 1993; Holt *et al.*, 1998); and mussels may be absent from areas of high boating activity, presumably due to TBT (Holt *et al.*, 1998). Mortality in *Alcyonium digitatum* was reported after exposure to the dispersant BP 1002 (Smith, 1968) whereas Smith (1968) found *Urticina felina* to be one of the more resistant species on the shore after the Torrey Canyon oil spill and Hoare & Hiscock (1974) reported it relatively close of a halogenated effluent discharge in Amlwch where other organisms were unable to survive. PCB exposure resulted in defective larvae in *Asterias rubens* (Besten *et al.*, 1989). Barnacles, such as *Balanus crenatus* were considered to be highly intolerant of chemical contaminants (Holt *et al.*, 1995). No information was found concerning the effect of contaminants hydroids, bryozoans or ascidians. Therefore, chemical contamination may cause mortalities and sub-lethal effects in the *Mytilus edulis* bed but affect other members of the community to varying degrees, and an overall intolerance of intermediate has been recorded. Recovery of the mussel beds will probably require recruitment from other areas, while most other members of the community will recolonize rapidly and a recoverability of high has been reported (see additional information below).
Radionuclide contamination	Insufficient information.
Nutrient enrichment	Moderate nutrient enrichment, especially in the form of organic particulates and dissolved organic material, is likely to increase food availability for all the suspension feeders within the biotope. Therefore, 'tolerant*' has been recorded. However, long term or high levels of organic enrichment may result in deoxygenation and algal blooms. *Mytilus edulis* has been reported to suffer mortalities due to algal blooms of *Gyrodinium aureolum* and *Phaeocystis poucheri* (Holt *et al.*, 1998). Circalittoral populations may be too deep to be affected by feeding on toxic algae. However, death of toxic and non-toxic algal blooms may result in large numbers of dead algal cells collecting on the sea bottom, resulting in local de-oxygenation as the algal decompose. Although, *Mytilus edulis* is probably tolerant of anoxic conditions other members of the community may be more intolerant (see oxygenation below).
Habitat structure changes - removal of substratum (extraction)	Removal of the substratum will include the removal of all the species within the biotope. Therefore, an intolerance of high has been recorded. Although a single good recruitment event may recolonize the substratum within a year, recovery may take up to 5 years, and is some circumstances significantly longer (see additional information below). Therefore, a recoverability of high has been recorded.
Heavy abrasion, primarily at the seabed surface	Wave driven logs have been reported to influence *Mytilus edulis* populations, causing the removal of patches from extensive beds that subsequently open the beds to further damage by wave action (Holt *et al.*, 1998). A similar effect could be caused by a vessel grounding. Little information on physical disturbance in subtidal *Mytilus* spp. beds was found. Fishing activities, e.g. scallop dredging are know to physically disturb marine communities. However, benthic trawls tend to avoid rough ground, such as reefs and rocky areas. *Modiolus modiolus* beds have been reported to have declined off the Isle of Man due to scallop dredging, presumably because the scallop dredging activity had damaged the edges of denser beds over time (Jones, 1951; Holt *et al.*, 1998). Benthic trawls, where they occur, may affect *Mytilus edulis* beds similarly. Scallop dredging and otter trawls have also been reported to damage *Alcyonium digitatum* (Hartnoll, 1998; Holt *et al.*, 1998). Starfish, such as *Asterias*
Light abrasion at the surface only	

	rubens have been reported to be damaged by benthic dredges, but have considerable regenerative capability, and, as scavengers, benefit from the presence of other damaged or killed animals (Emson & Wilkie, 1980; Gubbay & Knapman, 1999). Therefore, it is likely that abrasion or impact at the level of the benchmark (a passing scallop dredge) would damage or remove patches of the population and an intolerance of intermediate has been recorded. Recovery is dependant on recruitment of *Mytilus edulis* from outside the biotope and a recoverability of high has been reported (see additional information below).
Siltation rate changes	Intertidal *Mytilus edulis* beds have been reported to suffer mortalities as a result on smothering by large scale movements of sand or sand scour (Holt *et al.*, 1998; Daly & Mathieson, 1977). Similarly, biodeposition within a mussel bed results in suffocation or starvation of individuals that cannot re-surface. Young mussels have been shown to move up through a bed, avoiding smothering, while many others were suffocated (Dare, 1976; Holt *et al.*, 1998). This suggests that a proportion of the population may be able to avoid smothering in subtidal conditions, and, therefore, an intolerance of intermediate has been recorded. Although, *Mytilus edulis* is highly fecund, larval mortality is high. Larval development occurs within the plankton over ca 1 month (or more), therefore, whilst recruitment within the population is possible, it is likely that larval produced within the biotope are swept away from the biotope to settle elsewhere . Therefore, recovery is dependant on recruitment from outside the biotope and a recoverability of high has been reported (see additional information below).
	Mytilus edulis has been reported to be relatively tolerant of suspended sediment and siltation and survived over 25 days at 440mg/l and on average 13 days at 1200mg/l (Purchon, 1937; Moore, 1977). *Mytilus edulis* also has efficient pseudofaeces discharge mechanisms (Moore, 1977; de Vooys, 1987). Similarly *Asterias rubens* flourishes in naturally turbid conditions and is capable of cleansing itself of adherent mud particles (Moore, 1977). However, both species probably suffer a metabolic cost resulting from the cleansing mechanisms, mucus production and interrupted or impaired feeding. Similarly, *Urticina felina*, *Alcyonium digitatum* and *Balanus crenatus* were considered to be of low intolerance to suspended sediment. In addition, the strong tidal streams characteristic of the biotope probably prevent suspended sediment settling out and hence reduces siltation. Therefore, a biotope intolerance of low, at the benchmark level, has been recorded. Hydroids, such as *Sertularia* spp. and *Kirchenpaueria pinnata* are likely to be more intolerant of siltation (Hiscock, 1983). However, greater increases in siltation may reduce the abundance of hydroids, bryozoans and anthozoans within the biotope especially on upward facing surfaces. The majority of the organisms within the biotope probably have mechanisms to deal with siltation and suspended sediment, so that recoverability of immediate has been recorded.
	A decrease in suspended sediment, especially organic particulates could potentially reduce the food available to *Mytilus edulis* and the other suspension feeders within the biotope. Therefore, an intolerance of low has been recorded.
Underwater noise changes	Although, some fish species may be scared off or deterred from feeding by underwater noise, the majority of the species within the biotope are unlikely to be adversely affected by, or detect underwater noise.
Visual disturbance	None of the species within the biotope are likely to be adversely affected or detect changes in visual presence at the benchmark level.

Introduction or spread of non-indigenous species.	The diseases and parasites of *Mytilus edulis* were reviewed by Bower (1992) and Bower & McGladdery (1996) (see the species review). The boring sponge *Cliona* spp. has been reported from *Modiolus modiolus* beds and may affect subtidal *Mytilus edulis* beds. Similarly subtidal beds may be affected by the boring polychaete *Polydora ciliata*. Both of the above boring species weaken the shell of the victim and makes them more vulnerable to predation. *Polydora ciliata* also causes blisters, atrophy of muscle tissue and interferes with gamete production and has resulted in substantial mortalities in European mussel populations. *Asterias rubens* may be parasitised by the ciliate *Orchitophyra stellarum* (Vevers, 1951; Bouland & Clareboudt, 1994) resulting in castration of males, and subsequent reduction in population size (Vevers, 1951). Therefore, an intolerance of intermediate has been recorded. Recovery of the mussel beds will be dependant on recruitment from other populations and a recoverability of high has been recorded (see additional information below).
Introduction of microbial pathogens	*Mytilus edulis* was regarded to be tolerant of a wide range of oxygen concentrations including zero (Zwaan de & Mathieu, 1992; Diaz & Rosenberg, 1995; see species review). However, echinoderms such as *Asterias rubens* are highly intolerant of anoxic conditions. Similarly, *Alcyonium digitatum* and *Balanus crenatus* were considered to be highly intolerant of anoxia. Little information regarding the tolerance of ascidians and hydroids to hypoxia was found. Although *Mytilus edulis* is likely to tolerate hypoxic conditions, an intolerance of intermediate has been recorded due to the intolerance of the other members of the community. It should be noted that in the presence of strong to moderate tidal streams, anoxic conditions are unlikely to occur unless combined with reduced water flow rates. Recoverability of the associated species is likely to be rapid (see additional information below).
Removal of target habitat	*Mytilus edulis* is an effective space occupier and few other species are able to out-compete it for space. However, the South American mytilid *Aulocomya ater* has been reported recently in the Moray Firth, Scotland in 1994 and again in 1997 (Holt *et al.*, 1998; Eno *et al.*, 1997; McKay, 1994). *Aulocomya ater* is thought to have a stronger byssal attachment than *Mytilus edulis* and may replace *Mytilus edulis* in more exposed areas if it reproduces successfully (Holt *et al.*, 1998).
Removal of non-target habitat	Large mussel beds in the intertidal and subtidal have been routinely fished for hundreds of years, and managed by local Sea Fishery Committees for the past hundred years (Holt *et al.*, 1998). Some shallow subtidal populations are found in turbid areas and are essentially circalittoral, and represented by this biotope. Subtidal mussel beds may be exploited dredging. Holt *et al.*, (1998) suggest that in particular embayments over-exploitation may reduce subsequent recruitment leading to long term reduction in the population or stock. The relationship between stock and recruitment is poorly understood. Loss of stock may have significant effects on other species, e.g. in the Dutch Wadden Sea in 1990 the mussel stocks fell to unprecedented low levels resulting in death or migration of eiders, and oystercatchers seeking alternative prey such as *Cerastoderma edule*, *Mya arenaria*, and *Macoma balthica*. Extraction of *Mytilus edulis* is likely to remove much of the epifaunal and infaunal community, resulting in a decline in species richness. Overall, an intolerance of intermediate has been recorded at the benchmark level of extraction. However, recovery is likely to occur within 5 years and a recoverability of high has been recorded (see additional information below).

2.2	**Burrowed mud CFiMU.MegMax**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	This biotope usually occurs within a temperature range of 5 - 10 °C and therefore is tolerant to long term temperature fluctuations. It is possible that some species within this biotope are more susceptible to short term, acute fluctuations. The majority of the deep burrowing species are likely to be tolerant of both acute and chronic temperature changes in the water column, due to the buffering effect of the sediment. *Virgularia mirabilis* may be more intolerant to short term temperature increases, however little information was found on sea pen's tolerance to temperature increases. The biotope as a whole is thought to be moderately tolerant to temperature fluctuations with high recoverability as it is thought species richness will be largely unaffected.
Temperature changes - local decrease	This biotope usually occurs within a temperature range of 5 - 10 °C and therefore is tolerant to long term temperature fluctuations. It is possible that some species within this biotope are more susceptible to short term, acute fluctuations. The majority of the deep burrowing species are likely to be tolerant of both acute and chronic temperature changes in the water column, due to the buffering effect of the sediment. *Virgularia mirabilis* may be more intolerant to short term temperature changes, however little information was found on sea pen's tolerance to temperature decreases.
Salinity changes - local increase	The biotope is found in fully marine conditions and therefore an increase is unlikely to affect the range in which this biotope is found. However, if a change in salinity was to occur the specific affects are unknown, such as the osmoregulatory abilities of burrowing megafauna . It is therefore likely that the species would be intolerant.
Water flow (tidal current) changes - local increase	This biotope occurs in areas of weak to very weak tidal streams and therefore is possibly intolerant to increased water flow. Increases in flow rate, especially long term, will change the surface layer of the sediment structure. The sea pen *Virgularia mirabilis* for example, will retract into the sediment at water currents speeds greater than 1 knot. If water flow rates remain above this level, sea pens may be unable to extend above the sediment, unable to feed and will die. Tolerance is likely to be moderate, with the possible loss of sea pens and deep burrowing species avoiding the effects of increases water flow. Recoverability is likely to be moderate.
Water flow (tidal current) changes - local decrease	This biotope occurs in areas of weak to very weak tidal streams, a decrease in flow rate would result in negligible water flow. Tidal streams transport and provide suspended sediments on which suspension feeders feed, a decrease in flow rate would result in a decline in suspended organic particles available. In certain locations (such as sea lochs) water may become deoxygenated, there may be a decline in species which are intolerant to deoxygenated water (see oxygenation, below). A decrease in water flow rate for the benchmark period of a year, could result in reduced growth and a decline in suspension feeders, for example *Virgularia mirabilis*. Burrowing megafaunal species, which are predominantly detrital feeders, are likely to be tolerant to a decrease in water flow. This biotope has been assessed as moderately tolerant, with a high recoverability.
Emergence regime changes - local increase	This biotope occurs in sublittoral sediments (below 10m) and therefore is not subject to emergence.

Emergence regime changes - local decrease	This biotope occurs in sublittoral sediments (below 10m) and therefore is not subject to emergence.
Wave exposure changes - local increase	The biotope occurs in sheltered or extremely sheltered areas, so a decrease in wave exposure is not likely to affect this biotope.
Wave exposure changes - local decrease	The dominant trophic group in this biotope is detritivores, productivity is mostly secondary, derived from detritus and organic material. Long term decreases in turbidity may increase the overall organic content of detritus, due to the contribution of primary production by pelagic phytoplankton and microphytobenthos. An increased food supply may boost growth rates and fecundity of some species in the biotope, so this biotope is assessed as tolerant to an increase in turbidity.
Water clarity increase	The dominant trophic group in this biotope is detritivores, productivity is mostly secondary, derived from detritus and organic material. Excess turbidity, as a consequence of organic enrichment, may contribute to a loss of megafaunal burrowers from polluted situations (Hughes, 1998). Long term increases in turbidity may reduce the overall organic content of detritus, due to the contribution of primary production by pelagic phytoplankton and microphytobenthos. Reduced food supply may affect growth rates and fecundity of some species in the biotope. Therefore, this biotope is said to be moderately tolerant to increased turbidity.
Water clarity decrease	Most species in the biotope appear to tolerate sediments relatively high in organic content. The superficial sediment layer is normally very rich in organic matter, with the organic content of the surface sediment remaining uniform throughout the year. The organic content of sediment has a major influence on the abundance and composition of megafaunal burrowing communities, organic enrichment is one of the most important factors affecting sediment communities (alongside trawling for *Nephrops norvegicus*) due to associated oxygen depletion (Hughes, 1998). In semi-enclosed sea lochs, aquaculture of Atlantic salmon is the most common source of organic enrichment. Organic pollution has several adverse consequences which are detrimental to burrowing megafauna. These include; hypoxia, physical burial, excess turbidity, the presence of associated toxins (e.g. in sewage sludge) or changes in sediment properties which are unfavourable to burrow maintenance (Hughes, 1998). Typically an increasing gradient of organic enrichment results in a decline in the suspension feeding fauna and an increase in the number of deposit feeders, in particular polychaete worms (Pearson & Rosenberg, 1978). Heavy organic pollution may reduce the abundance of burrowing megafauna within this biotope, such as *Nephrops norvegicus*. Burrowing megafauna are said to be tolerant of organic contents up to 9%. Sea pens are possibly not as tolerant to high organic contents and are reported to be present in areas with up to 4.5% (Atkinson, 1989). Mucus in the lining of *Maxmuelleria lankesteri* burrows may reduced the effects of harmful solutes in the sediment, such as sulphide, this may allow the worm to live in organically enriched sediments (Nickell *et al*, 1995). Increased nutrients and eutrophication processes may contribute to an increase in the accumulation of hydrophobic contaminants in *Amphiura filiformis* and their transfer to higher trophic levels (Gunnarsson & Skold, 1999). This biotope is assessed to be moderately tolerant to organic pollution, with a possible reduction in the abundance of sea pens.

	Recoverability is thought to be high, due to the bioturbative activity of burrowing megafauna present.
Nutrient enrichment	The majority of species within this biotope are burrowing megafauna or epifauna and a loss in substrate will result in a loss of these species, therefore tolerance is assessed as high. The life-history of the species within this biotope vary, mobile species may recolonise the area relatively quickly. *Callianassa subterranea* reaches maturity after a year and has a short life span of approximately 2-3 years. Little is known about the life-history of *Maxmuelleria lankersteri*, but it is a long-lived species with low recruitment rates. *Virgularia mirabilis* and the brittle star *Amphiura filiformis* are also relatively long-lived. This community of burrowing megafauna may recruit quickly however, will take longer than five years to reach sexual maturity and recover and so a recoverability rank of low is reported.
Habitat structure changes - removal of substratum (extraction)	This biotope supports the *Nephrops norvegicus* fishery and therefore may be subjected to heavy trawling. *Nephrops* populations exhibit a certain resilience to fishing pressure by the fact that juveniles and egg-carrying females remain within their burrows, therefore escaping capture. Since the majority of species within this biotope are deep burrow dwellers, such as the crustaceans *Callianassa subterranea* and *Jaxea nocturna* and the echiuran worm *Maxmuelleria lankesteri* and some burrowing fish, it is probable that these species avoid capture and therefore will be little affected by this type of disturbance. Abrasion and physical disturbance, such as that caused by trawling or scallop dredging, is likely to affect mobile and sessile species, such as *Virgularia mirablis*, and so intolerance is assessed as intermediate. Recoverability is assessed as high.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	The majority of species within this biotope are burrowing megafauna (*Maxmuelleria lankesteri*, bivalves and thalassinidean crustaceans) living in the sediment and therefore are likely to be tolerant to a smothering by 5 cm of sediment. The seapen, *Virgularia mirabilis*, is able to withdraw into the sediment and is likely to be tolerant of smothering. This biotope is likely to be tolerant to the benchmark level of sediment smothering. Burrowing species will be able to burrow through the additional layer of sediment in hours to days, so recoverability is moderate.
Siltation rate changes	The biotope is likely to be unaffected by an increase in suspended sediment as most of the species inhabit the sediment. An increase in suspended sediment may affect the feeding efficiency of suspension filters, such as *Virgularia mirabilis*, colonies will produce an increased amount of mucus to aid sediment removal or individual colonies may retract into the sediment. The energetic cost of polyp cleaning, however, is probably low, but if feeding rates are reduced there may be a decline in the population. Recoverability is likely to happen quickly.
	A decrease in suspended sediment and siltation will reduce the flux of particulate material to the seabed. The benchmark is a reduction in suspended sediment of 100 mg/l for a month, this is unlikely to have a significant effect on the species in this biotope.
	There are no known examples of disease affecting species in this biotope, but recently a parasitic dinoflagellate, *Hematodinium* sp., has become prevalent in *Nephrops norvegicus* populations around Scotland, this is has great implications for the *Nephrops* fishery (Hughes, 1998). Recovery appears to be possible within five years.
Underwater noise changes	There were no reports found of non-native species invading this biotope, but there is increasing concern about the effects of introduced non-native species, especially as a result of human activities (eg. ballast water) (Carlton, 1996).

	Several species have become established in British waters, so there is always the potential for new introduced non-native species to have an effect on the biotope.
Visual disturbance	Macrofaunal diversity and abundance is greater in sediments colonised by dense populations of burrowing megafauna, with a marked decline in community diversity following the loss of these species. The bioturbative activity of all megafaunal burrowers in this biotope increase oxygenation of sediment, enhancing the survival of smaller species (Pearson & Rosenberg, 1978). *Maxmuelleria lankesteri* produces long-lasting burrows that provide a habitat for a variety of small polychaetes and bivalves which colonise burrow walls, increasing the spatial stability of burrows (Nickell *et al.*, 1995). The removal of individual burrowing species is unlikely to be detrimental to the community, since there are other burrowing fauna present. An intolerance of intermediate is suggested to reflect the loss of key megafaunal burrowers, such as *Maxmuelleria lankesteri* and *Nephrops norvegicus*.
Introduction or spread of non-indigenous species.	This biotope usually occurs within a temperature range of 5 - 10 °C and therefore is tolerant to long term temperature fluctuations. It is possible that some species within this biotope are more susceptible to short term, acute fluctuations. The majority of the deep burrowing species are likely to be tolerant of both acute and chronic temperature changes in the water column, due to the buffering effect of the sediment. *Virgularia mirabilis* may be more intolerant to short term temperature increases, however little information was found on sea pen's tolerance to temperature increases. The biotope as a whole is thought to be moderately tolerant to temperature fluctuations with high recoverability as it is thought species richness will be largely unaffected.
Introduction of microbial pathogens	This biotope usually occurs within a temperature range of 5 - 10 °C and therefore is tolerant to long term temperature fluctuations. It is possible that some species within this biotope are more susceptible to short term, acute fluctuations. The majority of the deep burrowing species are likely to be tolerant of both acute and chronic temperature changes in the water column, due to the buffering effect of the sediment. *Virgularia mirabilis* may be more intolerant to short term temperature changes, however little information was found on sea pen's tolerance to temperature decreases.
Removal of target habitat	The biotope is found in fully marine conditions and therefore an increase is unlikely to affect the range in which this biotope is found. However, if a change in salinity was to occur the specific affects are unknown, such as the osmoregulatory abilities of burrowing megafauna. It is therefore likely that the species would be intolerant.
Removal of non-target habitat	This biotope occurs in areas of weak to very weak tidal streams and therefore is possibly intolerant to increased water flow. Increases in flow rate, especially long term, will change the surface layer of the sediment structure. The sea pen *Virgularia mirabilis* for example, will retract into the sediment at water currents speeds greater than 1 knot. If water flow rates remain above this level, sea pens may be unable to extend above the sediment, unable to feed and will die. Tolerance is likely to be moderate, with the possible loss of sea pens and deep burrowing species avoiding the effects of increases water flow. Recoverability is likely to be moderate.

2.2	Burrowed Mud Cmy.SpMeg
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	In shallow sea lochs, sedimentary biotopes typically experience seasonal changes in temperature of about 10 °C and so CMU.SpMeg may be tolerant of long term increases although growth and fecundity of some species may be affected. No information was found on the upper limit of sea pens tolerance to temperature increases. However, the distribution of the sea pens typically found in the biotope, *Virgularia mirabilis*, *Pennatula phosphorea* and *Funiculina quadrangularis*, extends south into the warmer waters of the Mediterranean suggesting they may be able to tolerate a long term increase in temperature of 2 °C. However, sea pens are subtidal animals where wide and rapid variations in temperature, such as experienced in the intertidal, are not so common and so may be more intolerant of a short term increase of 5 °C. The reported intolerance to changes in temperature for *Virgularia mirabilis* is intermediate. Since the loss of sea pens changes the biotope the intolerance of the biotope to increased temperature is also recorded as intermediate. For most deep burrowing species temperature changes in the water column are likely to be buffered to some extent by the sediment and so many individuals will not be affected. See additional information for details of recovery.
Temperature changes - local decrease	In shallow sea lochs, sedimentary biotopes typically experience seasonal changes in temperature of about 10 °C and so CMU.SpMeg may be tolerant of long term decreases although growth and fecundity of some species may be affected. No information was found on the lower limit of sea pens tolerance to temperature decreases. However, the distribution of the sea pens typically found in the biotope, *Virgularia mirabilis*, *Pennatula phosphorea* and *Funiculina quadrangularis*, extends into the northern North Atlantic where waters are colder than in the UK suggesting they may be able to tolerate a long term decrease in temperature of 2°C. However, sea pens and other species in the biotope are subtidal where wide and rapid variations in temperature, such as experienced in the intertidal, are not so common and so may be more intolerant of a short term decrease in temperature of 5°C. For most deep burrowing species temperature changes in the water column are likely to be buffered to some extent by the sediment and so many individuals will not be affected. During the very cold winter of 1962-63 a few dead *Nephrops norvegicus* were caught in the North Sea although the majority were caught alive (Crisp, 1964), therefore it seems likely that burrowing species will probably be not sensitive to the factor. Since one of the key faunal groups, the sea pens may be intolerant of a short term decrease and the viability of populations may be threatened the intolerance of the biotope to decreased temperature is recorded as intermediate. See additional information for details of recovery.
Salinity changes - local increase	The biotope is found in fully marine conditions so is likely to be intolerant of increases in salinity. The overall effect on the biotope of a chronic decrease in salinity for a period of a year is likely to be the loss of most species and so intolerance is reported as high. Recovery is likely to take longer than five years and has been recorded as moderate (see additional information).
Water flow (tidal current) changes - local increase	The biotope is found in areas of weak or very weak tidal streams and so is likely to be intolerant of increases in water flow. Strong tidal currents keep most of the organic particles in the sediment in suspension which can support suspension feeders even in low organic content sediments. The horizontal supply of small and light nutritious particles by resuspension and adjective

	transport has been shown to influence the growth rate of suspension-feeding benthos (Dauwe, 1998). However, some suspension feeders in the biotope will be unable to feed if the water flow rate increases by two categories in the water flow scale (see benchmarks). The sea pen *Virgularia mirabilis* for example, will retract into the sediment at water currents speeds greater than 0.5m/s (i.e. 1 knot). If water speeds remain at this level or above, the sea-pen will be unable to extend above the sediment, unable to feed and will die. Increases in flow rate will change the surface layer of the sediment structure, removing the fine mud element to leave the coarser particles behind. A long term increase (i.e. the benchmark level of one year) will change the nature of the top layers of sediment, becoming coarser and possibly unsuitable for some shallow burrowing species such as the brittle stars *Amphiura*. Deeper burrowing species such as the thalassinidean crustaceans *Callianassa subterranea* and *Nephrops norvegicus* are not likely to be affected by sediment changes at the surface. The overall impact of an increase in water flow rate on the biotope may be the loss of some key species, such as sea pens, which changes the biotope, and some other species such as brittle stars and so intolerance is assessed as high. In slightly more energetic conditions and coarser sediment the biotope CMS. AfilEcor which includes *Callianassa subterranea* and sparse *Virgularia mirabilis* is more likely to be present. Recovery has been assessed as high (see additional information).
Water flow (tidal current) changes - local decrease	The biotope exists in habitats where tidal streams are already very weak so a decrease in flow rate would result in almost non-moving water. Tidal currents keep most of the organic particles in the sediment in suspension which can support suspension feeders even in low organic content sediments. Therefore, if water movement becomes negligible suspended organic particles available to filter feeders such as the sea pens will decline. Growth and fecundity will be affected and over a period of a year may result in the death of sea pens. In enclosed or semi-enclosed water bodies, such as sea lochs, negligible water flow may result in some deoxygenation of the overlying water and the loss of some intolerant species. The sea pen *Virgularia mirabilis* for example, has high intolerance to deoxygenation and may die. However, other species such as *Callianassa subterranea* and many other thalassinidean crustaceans are tolerant of reduced oxygenation and are not likely to die. The overall impact on the biotope is likely to be the loss of a few key species such as sea pens and so intolerance is assessed as high. Recovery has been assessed as high (see additional information).
Emergence regime changes - local increase	The biotope only occurs in the circalittoral zone (below 15 m) and is not subject to emergence.
Emergence regime changes - local decrease	The biotope only occurs in the circalittoral zone (below 15 m) and is not subject to emergence.

Wave exposure changes - local increase	The biotope exists in areas with physically-sheltered conditions of low wave exposure and weak tidal currents. An increase in wave exposure is likely to change the composition of species present in the biotope because it is likely to disrupt feeding and burrowing and may also have an impact on reproduction and recruitment. An increase in the factor can also change the sediment characteristics which may result in a change in the proportion of suspension to deposit feeders within it. Sea pens, for example, may be unable to feed and may be damaged or broken by increased wave exposure. *Virgularia mirabilis* is able to withdraw into the sediment to avoid the factor but will be unable to feed if wave exposure increases are long term and will be likely to die. Coarser material is more difficult to burrow through, and organisms need to be robust to survive and so a major decline in the number of species able to inhabit the biotope is likely to result. Even very deep burrowing species like *Callianassa subterranea* are likely to be affected because increased wave exposure will probably disturb burrow openings and water flow through the burrows making feeding difficult. With the loss of key species, in particular the sea pens, the biotope will change so intolerance is assessed as high. See additional information for details of recovery.
Wave exposure changes - local decrease	The biotope occurs in areas of very low or no wave exposure so a decrease is not relevant.
Water clarity increase	A decrease in turbidity, increasing light availability may increase primary production by phytoplankton in the water column. However, productivity in the CMU.SpMeg biotope is secondary (detritus) and is not likely to be significantly affected by changes in turbidity and so intolerance is assessed as low. In estuaries and surf zones on the lower shore turbidity can be measured in g/l so the benchmark level is low in comparison. Nevertheless, primary production by pelagic phytoplankton and microphytobenthos do contribute to benthic communities and long term decreases in turbidity may increase the overall organic input to the detritus. Increased food supply may increase growth rates and fecundity of some species in the biotope. *Nephrops norvegicus* avoid bright light and exposure to high intensities causes blindness (Loew, 1976) and so a decrease in light attenuation resulting from decreased turbidity may affect the depth at which the species is present or more likely that *Nephrops* will only feed at night. See additional information for details of recovery.
Water clarity decrease	An increase in turbidity, reducing light availability may reduce primary production by phytoplankton in the water column. However, productivity in the CMU.SpMeg biotope is secondary (detritus) and is not likely to be significantly affected by changes in turbidity and so intolerance is assessed as low. In estuaries and surf zones on the lower shore turbidity can be measured in g/l so the benchmark level is low in comparison. Nevertheless, primary production by pelagic phytoplankton and microphytobenthos do contribute to benthic communities and so long term increases in turbidity may reduce the overall organic content of the detritus. Reduced food supply may affect growth rates and fecundity of some species in the biotope so intolerance is assessed as low. On return to normal turbidity levels recovery will be high as food availability returns to normal.

Non-synthetic compound contamination (incl. heavy metals)	In Norwegian fjords Rygg (1985) found a relationship between species diversity in benthic fauna communities and sediment concentrations of heavy metals Cu, Pb and Zn. Cu in particular showed a strong negative correlation and the author suggested a cause -effect relationship. Those species not present at sites where Cu concentrations were greater than ten times higher than the background level, such as *Calocaris macandreae*, *Amphiura filiformis* and several bivalves including *Nucula sulcata* and *Thyasira equalis*, were assessed as non-tolerant species. The tolerant species were all polychaete worms. Therefore, increased heavy metal contamination in sediments may change the faunal composition of the community and decrease overall species diversity and intolerance has been assessed intermediate. Some burrowing crustaceans, brittle stars and bivalves may disappear from the biotope and lead to an increasing dominance of polychaetes. There was no information found on the effect of heavy metals on sea pens. Recovery is likely to be high.
Non-synthetic compound contamination (incl. hydrocarbons)	There was no information found on the effect of hydrocarbon pollution on the biotope. The best documented oil spill for protected habitats with soft mud/sand substrates is the West Falmouth, Florida spill of 1969. Immediately after the spill virtually the entire benthic fauna was eradicated immediately following the incident and populations of the opportunistic polychaete *Capitella capitata* increased to abundances of over 200,000/m^2 (Sanders, 1978). Persistent toxicity of Amoco Cadiz oil in sediment prevented the start of the recovery period (Clark, 1997). *Callinanassa subterranea* appears to be highly intolerant of sediment contaminated by oil-based drilling muds (Daan *et al*., 1992). Oil from spills would have to be dispersed deep into the water column to affect the biotope and since the biotope occurs in very sheltered conditions this is unlikely to occur. However, should the sediment become contaminated with oil there is likely to be the loss of many species and so intolerance is assessed as high. Nothing is known about the life cycle and population dynamics of British sea pens, but data from other species suggest that they are likely to be long-lived and slow growing with patchy and intermittent recruitment. The burrowing megafauna in the biotope vary in their longevity and reproductive strategies and some species do not reach sexual maturity for several years. *Calocaris macandreae*, for example, does not reproduce until five years old. Therefore, it seems likely that a community of sea pens and burrowing megafauna may take longer than five years to recover and so a recoverability rank of moderate is reported.
Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	The biotope is found in fully marine conditions and does not extend into estuaries so is likely to be intolerant of decreases in salinity. The key species are highly intolerant of salinity changes although Jones *et al.* (2000) suggest that *Virgularia mirabilis* appears to be somewhat tolerant of occasional lowering of salinity. However, the species is found only in fully marine environments and so is likely to be intolerant of a long term, chronic decrease; e.g., a change of one category from the MNCR salinity scale for one year. The overall effect on the biotope of a chronic decrease in salinity for a period of a year is likely to be the loss of most species and so intolerance is reported as high. Recovery is likely to take longer than five years and has been recorded as moderate (see additional information).
Radionuclide contamination	Most species in the biotope appear to tolerate sediments relatively high in organic content. In Loch Sween in Scotland, for example, where the organic content is about 5% and as high as 9% in some areas burrowing species such as the crustaceans *Callianassa subterranea*, *Calocaris macandreae* and *Nephrops norvegicus* and the echiuran worm *Maxmuelleria lankesteri* are present in high densities. Although absent from the most enriched areas the sea pen *Virgularia mirabilis* was present at organic contents of 4.5% (Atkinson,

	1989). Very large increases in organic content can result in significant changes in community composition of sedimentary habitats and sometimes defaunation. Typically an increasing gradient of organic enrichment results in a decline in the suspension feeding fauna and an increase in the number of deposit feeders, in particular polychaete worms (Pearson & Rosenberg, 1978). For example, in areas under fish farm cages gross organic pollution has been observed to result in the loss of megafaunal burrowers. However, these changes generally refer to gross nutrient enrichment. At the level of the benchmark, a 50% increase in nutrients is likely to impact only the most intolerant species and may result in a reduction in the number of sea pens so intolerance is assessed as intermediate. A high recovery is expected (see additional information).
De-oxygenation Nutrient enrichment	Most species are infaunal or epifaunal and will be lost if the substratum is removed so the overall intolerance of the biotope is high. Although some of the mobile species in the biotope may be able to escape, most, such as the harbour swimming crab *Liocarcinus depurator* and the starfish *Asterias rubens* are not very fast moving and so are also likely to be removed. Nothing is known about the life cycle and population dynamics of British sea pens, but data from other species suggest that they are likely to be long-lived and slow growing with patchy and intermittent recruitment. The burrowing megafauna in the biotope vary in their longevity and reproductive strategies and some species do not reach sexual maturity for several years. *Calocaris macandreae*, for example, does not reproduce until five years old. Therefore, it seems likely that a community of sea pens and burrowing megafauna may take longer than five years to recover and so a recoverability rank of moderate is reported (see additional information). The biotope is subject to physical disturbance because it supports a major fishery for one of its characteristic species, *Nephrops norvegicus*. Information on the effects of trawling on the other fauna in the biotope is limited but it is likely that the deep burrowing species such as the crustaceans *Callianassa subterranea* and *Jaxea nocturna* and the echiuran worm *Maxmuelleria lankesteri* and some burrowing fish will be little affected by this type of disturbance. Individual burrowing crustaceans may occasionally be displaced from burrow openings by towed gear (Atkinson, 1989). However, the animals will be able to re-establish burrow openings if these become blocked so recovery would be immediate. Of the three sea pen species *Funiculina quadrangularis* is likely to be the most sensitive to abrasion and disturbance because it has a long brittle stalk and is unable to retract into the sediment. However, experimental studies have shown that all three species of seapen can re-anchor themselves in the sediment if dislodged by fishing gear (Eno *et al*., 1996). Eno *et al*. (1996) found that even if damaged *Funiculina quadrangularis* appeared to remain functional and this could also be true of the other sea pens. However, the apparent absence of *Funiculina* from open-coast *Nephrops* grounds may be a consequence of its susceptibility to trawl damage (D.W. Connor, pers. comm. in Hughes, 1998b).

	In long term experimental trawling Tuck *et al.* (1998) found no effect on *Virgularia mirabilis* populations and Kinnear *et al.* (1996) found that sea pens were quite resilient to being smothered, dragged or uprooted by creels. The investigation by Tuck *et al*. (1998) examined the effects of extensive and repeated experimental trawl disturbance on whole benthic communities over an 18 month period in a Scottish loch that had previously been un-fished for 25 years. The subsequent patterns of recovery over a further 18 month period were also investigated. Trawling disturbance resulted in reduced species diversity and a disproportionate increase in the abundance of a few dominant species, in particular the opportunistic polychaetes *Chaetozone setosa* and *Caulleriella zetlandica*. Other species, also found in this biotope, that were observed to be sensitive include the bivalves *Nucula nitidosa* and *Corbula gibba* and the polychaetes *Nephtys* sp. and *Terebellides stroemi*. For epifaunal species, no long-term effects on the total number of species or individuals were detected, but individual species did show effects, notably an increase in the density of *Ophiura* sp. and a decrease in numbers of the fish *Hippoglossoides platessoides* and the whelk *Buccinum undatum*. Other authors have also suggested that increases in echinoderm populations in the North Sea are associated with fishing disturbance (Aronson, 1990; Lindley et al., 1995). Scavenging species such as *Liocarcinus depurator*, *Pagurus bernhardus* and *Asterias rubens* might be expected to benefit from fishing disturbance, through increased food availability. Kaiser & Spencer (1994) found that benthic disturbance by fishing gear caused an increase in the density of epifaunal scavengers, in response to an increase in food availability in the form of damaged and disturbed organisms. The long term effects on infauna were still noticeable after 18 months and short term effects on epifauna recovered 6 months after fishing ceased. During long term monitoring of fishing disturbance on the Northumberland coast Frid *et al*. (1999) observed a decrease in numbers of sedentary polychaetes, echinoid echinoderms and large (>5 cm) brittlestars. Observations of the effects of *Nephrops* trawl fishing in the Irish Sea led Ball *et a*l. (2000a) to suggest that the bivalves *Corbula gibba* and *Thyasira flexusa* were sensitive to fishing disturbance. Thus, it appears that abrasion and physical disturbance, such as that caused by fish trawling or scallop dredging, is likely to affect the species composition of the biotope and so intolerance is assessed as intermediate. Recovery is expected to be high (see additional information).
Habitat structure changes - removal of substratum (extraction)	The biotope will have low intolerance to smothering by 5 cm of sediment because most species are burrowing and live within the sediment anyway. The burrowing thalassindean crustaceans, the echiuran worm *Maxmuelleria lankesteri*, infaunal polychaetes, brittlestars and bivalves are not likely to be affected by smothering by 5 cm of sediment. There may be an energetic cost expended to either re-establish burrow openings or to move up through the sediment though this is not likely to be significant. The sea pens *Virgularia mirabilis* and *Pennatula phosphorea* are able to withdraw rapidly into the sediment and appear to be able to recover from smothering. Although the sea pen *Funiculina quadrangularis* is not able to withdraw into the sediment its height, up to 2m, means that it is unlikely to be affected by smothering of 5cm of sediment. Most animals will be able to reburrow or move up through the sediment within hours or days so recovery is set at immediate (see additional information). Intolerance to smothering by other factors such as oil may be higher.

Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	Most species in the biotope are burrowing infauna so will not be affected by an increase in suspended sediment. There may be possible clogging of the feeding organs of the suspension feeding sea pens although since these animals are able to self-clean this is not likely to be very energetically costly, particularly at the level of the benchmark. Some species may benefit from increased food supply if suspended sediment has a high organic content. However, since most species in the biotope have low intolerance to an increase in suspended sediment at the benchmark level an overall rank of low is also reported for the biotope. Overall species composition and richness is not expected to be affected. On return to normal, suspended sediment levels recovery will be immediate as affected species will be able to self-clean within a few days. A decrease in suspended sediment and siltation will reduce the flux of particulate material to the seabed. Since this includes organic matter the supply of food to the biotope would probably also be reduced. However, the benchmark is a reduction in suspended sediment of 100 mg/l for a month which is unlikely to have a significant effect on the biotope and would not alter species composition. Intolerance is therefore, assessed as low. On return to normal conditions, recovery will be rapid and a rank of very high is recorded.
Siltation rate changes	Some of the important characterizing species associated with this biotope, in particular the sea pens, may respond to sound vibrations and can withdraw into the sediment. Feeding will resume once the disturbing factor has passed. However, most of the species are infaunal and likely to be not sensitive to noise disturbance at the benchmark level. It is possible that predator avoidance behaviour in *Liocarcinus depurator* and other species may be triggered by noise vibrations although this has not been recorded. Therefore, unless predation pressure is reduced increased noise disturbance is not likely to have an impact on the nature and function of the biotope and a rank of not sensitive is recorded.
	Most species within the biotope are burrowing and have no or poor visual perception and are unlikely to be affected by visual disturbance such as shading. Epifauna such as crabs have well developed visual acuity and are likely to respond to movement in order to avoid predators. However, it is unlikely that the species will be affected by visual disturbance at the benchmark level. The biotope is therefore, not sensitive to the factor.
	The only major disease causing organism found in the biotope is the dinoflagellate parasite, *Hematodinium* sp. found in *Nephrops* populations from the west of Scotland, Irish Sea and North Sea (Hughes, 1998b). The parasite occurs in the blood and connective tissue spaces and appears to cause death by blocking the delivery of oxygen to the host's tissues (Taylor *et al*., 1996). Infection is at its highest in the spring and early summer when a dense concentration of parasite cells in the blood give *Nephrops* an abnormal bright orange body and milky white ventral abdomen. Heavily infected animals become moribund, spend more time out of their burrows than healthy individuals making them more vulnerable to predation and fishing gear. Heavy infestation is fatal. The ecological consequences of *Hematodinium* infection and host mortality in *Nephrops* populations are unknown, but there are potential economic implications, since the disease adversely affects meat quality. Since the parasite can cause mortality of a species within the biotope intolerance is assessed as intermediate. However, so far the *Nephrops* fishery has not suffered any serious decline. The infection appears to be cyclical. In the Clyde Sea infection peaked in 1991-92 at 70% and had declined to 10 – 20% by 1996-7 so recovery appears to be possible within five years and so a rank of high is reported.

Underwater noise changes	Large active animals with high respiratory demands will be most affected by oxygen depletion. In moderately hypoxic conditions (1mg l $^{-1}$) *Nephrops norvegicus* compensates by increasing production of haemocyanin (Baden *et al*., 1990). In the laboratory this compensation lasted one week so at the level of the benchmark the species will not be killed. However, at levels of about 0.6 mg l^{-1} the species died within 4 days. Catches of *Nephrops norvegicus* have been observed to be high when oxygenation in the water is low, probably because animals are forced out their burrows. Thalassinidean mud-shrimps are very resistant to oxygen depletion and enriched sulphide levels. *Callianassa subterranea*, for example, often lives in hypoxic or even anoxic conditions. *Virgularia mirabilis* is often found in sea lochs so may be able to tolerate some reduction in oxygenation. However, Jones *et al*., (2000) found sea pen communities to be absent from areas which are deoxygenated and characterized by a distinctive bacterial community and Hoare & Wilson (1977) reported *Virgularia mirabilis* absent from sewage related anoxic areas of Holyhead harbour. Therefore, the benchmark level of 2 mg/l of oxygenation for one week will result in the death of only the most intolerant species and maybe some individual sea pens. The total loss of populations of the key is not likely to occur at the benchmark level and since the faunal composition of the overall biotope is unlikely to change to any great extent intolerance is assessed as low. On return to normal oxygenation recovery will be immediate as respiratory rates return to normal. However, recruitment of intolerant species that are killed will be required to return the biotope to pre-impact species diversity.
Visual disturbance	There are no records of any non-native species invading the biotope and so is assessed as not sensitive. However, as several species have become established in British waters there is always the potential for new introduced non-native species to have an effect on the biotope.
Introduction or spread of non-indigenous species.	*Nephrops norvegicus* is a characterizing species and *Nephrops* fisheries are of major economic importance. The species is fished throughout most of the geographic range of the biotopes in which it occurs including CMU.SpMeg. In trawled areas it is likely that the density of *Nephrops norvegicus* has been reduced but Hughes (1998b) reports that most stocks have the potential to recover even after heavy fishing pressure. Atkinson (1989) concluded that trawling for *Nephrops* was unlikely to affect other megafaunal burrowers to any great extent. The upper section of burrows will be disrupted by trawling but observations in Loch Sween have shown that surface openings are soon re-established (Hughes, 1998b). Some sea pens are likely to be uprooted by trawling activities although in observations of the impact of creeling activities all three British species proved able to re-anchor themselves provided the basal peduncle remained in contact with the sediment surface. Crabs such as *Liocarcinus depurator* are often extracted as a by-catch species in benthic trawling. A reduction in the density of predators may affect species abundance but is not likely to have a significant effect on overall species diversity. Removal of *Nephrops norvegicus* would probably not change the nature of the biotope because there are likely to be other megafaunal burrowers present. None of the key or important species in the biotope are targeted for collection or harvesting. An intolerance of intermediate has been suggested to reflect likely loss of *Nephrops norvegicus*. Recovery is likely to be high.
Introduction of microbial pathogens	In shallow sea lochs, sedimentary biotopes typically experience seasonal changes in temperature of about 10 °C and so CMU.SpMeg may be tolerant of long term increases although growth and fecundity of some species may be affected. No information was found on the upper limit of sea pens tolerance to temperature increases. However, the distribution of the sea pens typically

	found in the biotope, *Virgularia mirabilis*, *Pennatula phosphorea* and *Funiculina quadrangularis*, extends south into the warmer waters of the Mediterranean suggesting they may be able to tolerate a long term increase in temperature of 2 °C. However, sea pens are subtidal animals where wide and rapid variations in temperature, such as experienced in the intertidal, are not so common and so may be more intolerant of a short term increase of 5 °C. The reported intolerance to changes in temperature for *Virgularia mirabilis* is intermediate. Since the loss of sea pens changes the biotope the intolerance of the biotope to increased temperature is also recorded as intermediate. For most deep burrowing species temperature changes in the water column are likely to be buffered to some extent by the sediment and so many individuals will not be affected. See additional information for details of recovery.
Removal of target habitat	In shallow sea lochs, sedimentary biotopes typically experience seasonal changes in temperature of about 10 °C and so CMU.SpMeg may be tolerant of long term decreases although growth and fecundity of some species may be affected. No information was found on the lower limit of sea pens tolerance to temperature decreases. However, the distribution of the sea pens typically found in the biotope, *Virgularia mirabilis*, *Pennatula phosphorea* and *Funiculina quadrangularis*, extends into the northern North Atlantic where waters are colder than in the UK suggesting they may be able to tolerate a long term decrease in temperature of 2°C. However, sea pens and other species in the biotope are subtidal where wide and rapid variations in temperature, such as experienced in the intertidal, are not so common and so may be more intolerant of a short term decrease in temperature of 5°C. For most deep burrowing species temperature changes in the water column are likely to be buffered to some extent by the sediment and so many individuals will not be affected. During the very cold winter of 1962-63 a few dead *Nephrops norvegicus* were caught in the North Sea although the majority were caught alive (Crisp, 1964) therefore it seems likely that burrowing species will probably be not sensitive to the factor. Since one of the key faunal groups, the sea pens may be intolerant of a short term decrease and the viability of populations may be threatened the intolerance of the biotope to decreased temperature is recorded as intermediate. See additional information for details of recovery.
Removal of non-target habitat	The biotope is found in fully marine conditions so is likely to be intolerant of increases in salinity. The overall effect on the biotope of a chronic decrease in salinity for a period of a year is likely to be the loss of most species and so intolerance is reported as high. Recovery is likely to take longer than five years and has been recorded as moderate (see additional information).

2.3	Coastal Saltmarsh:Lmu-SM
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Increases in temperature are like ly to result in increa sed evaporation and desiccation (see above). Howe ver, vascular plants are terrestrial in origin and adapted to relatively wider extremes of temperature than intertidal species.
Salinity changes - local increase	Saltmarsh plants live in habit an environment hostile to terr estrial p lants and are tolerant of fluctuating salinity, especially at the lower shore.
Water flow (tidal current) changes - local increase	Change in water flow rate and hence the hydrographic regime will change the accretion and erosion rates in the saltmarsh. Increases in water flow rate may erode areas at the face of the raise d salt marsh, resulting in a 'cliff' an d may undermine the edges o f creeks. R ecovery will depend on the accreti on of eroded sediment and subsequent r ecruitment of the pion eer specie s (see additional information below). Increases in water flow rate may erode areas at the face of t he raised salt marsh, resulting in a 'cliff' and may undermi ne the edges of cr eeks. Reco very will depend on the accretion o f eroded se diment and subsequent recruitment of the pioneer spe cies (see additional information below). Saltmarsh are accretin g habitats an d probably turbid. Tu rbidity reduces the light attenuation through water. However, salt marsh vegetation is emersed for the majority of the tidal cycle and able to photosynthesize.
Water flow (tidal current) changes - local decrease	Change in wave exposure and hence the hydrographic regime will change the accretion and erosion rates in the salt marsh, es pecially at low water exposed to immersion for longer periods. Incr eases in wave action may erode areas at the face of t he raised salt marsh, resulting in a 'cliff' and may undermi ne the edges of creeks. Recovery will de pend replacement of eroded sediment and the subsequent recruitment of the pioneer species (see additional information below).
Emergence regime changes - local increase	Increased emergence will allow spe cies typical of higher saltmarsh to invad e while allowing the pioneer species to colonize further offshore.
Emergence regime changes - local decrease	Decreased emergence, for exa mple due to se a level rise or barrage s, may move the h igh water mark furthe r up shore but this is not possible in the presence of sea defen ces. The low water ma rk moves inshore, effectively reducing the area availa ble for invertebrates and feeding of birds and f ish, so called 'coa stal squeeze' . Resultant increased w ater depth changes inf aunal feeding types and incr eases area available to predatory fish, and hen ce the community. Similarly it reduces the area available to shore birds and re duces the carrying capacity of the area for wildfowl. However, decreased emergence is likely to decrease the extent of the saltmarsh, mo ving the pi oneer community up shore.
Wave exposure changes - local increase	Change in wave exposure and hence the hydrographic regime will change the accretion and erosion rates in the salt marsh, es pecially at low water exposed to immersion for longer periods. Incr eases in wave action may erode areas at the face of t he raised salt marsh, resulting in a 'cliff' and may undermi ne the edges of cr eeks. Reco very will depend on re placement of eroded sediment

Wave exposure changes - local decrease	and the subsequent recruitment of the pioneer species (see additional information below).
Water clarity increase	Saltmarsh are accreting habitats and probably turbid. Turbidity reduces the light attenuation through water. However, salt marsh vegetation is emersed for the majority of the tidal cycle and able to photosynthesize.
Water clarity decrease	Salt marshes are dependant on suspended sediment to grow (accretion) and vulnerable to erosion, although a dynamic balance or erosion and accretion is probably normal. Die back of *Spartina anglica* in the Solent, southern England was associated with accumulation of very fine sediment, and changes in sediment type may affect saltmarsh communities (Holt et al., 1995). Increased siltation may increase sedimentation rates above growth rates resulting in smothering, whereas decreases siltation rates may reduce the rate of growth of the saltmarsh and subject it to increased erosion. Overall, any activity that changes the sedimentary regime could potentially have marked effects on saltmarsh. Therefore, an intolerance of high and a recoverability of moderate has been suggested (see additional information below).
Habitat structure changes - removal of substratum (extraction)	Removal of the substratum will remove the vegetation and infauna. Recovery will be dependant on recruitment. Pioneer species such as *Salicornia* sp. and *Aster tripolium* are likely to recover quickly whereas *Spartina* sp. will depend on transport of plant fragments and seed. Infaunal recovery will be dependant on recruitment form neighbouring intertidal populations and may take up to 5 years depending on the species, although mobile species will colonize quickly (e.g. ca I year).
Heavy abrasion, primarily at the seabed surface	Abrasion in saltmarsh biotopes is likely to result from trampling and vehicle use. In coastal plant communities trampling may favour plants with high growth rates, basal meristems, and low growth forms. Low levels of trampling encourage growth and species richness but these fall as trampling increases (Packham & Willis 1997). It is likely that succulents, such as *Salicornia* sp. are intolerant of trampling. Trampling may also affect the substratum, either through destabilization of creek walls and loss of vegetation, or may result in compaction of sediments and reduced aeration. Some plants will be damaged and invertebrates may be displaced but effects are likely to be restricted in area, therefore, an intolerance of intermediate has been recorded.
Light abrasion at the surface only	
Siltation rate changes	Smothering by 5cm of sediment may cover small plants, removing them from light. However, saltmarsh plants are adapted to accreting environments and may not be adversely affected by smothering for a month, depending on the species and the grain size of the smothering material e.g. die back of *Spartina anglica* in the Solent, southern England was associated with accumulation of very fine sediment. The intolerance of epifaunal burrowers and suspension feeders was higher than deep burrowing siphonate species (Hall, 1994).
Underwater noise changes	Disturbance by noise and visual presence of human activities to bird populations are difficult to separate and have been considered together. The level of disturbance is dependant on the species considered. Some species habituate to noise and visual disturbance while others become more nervous. For example, brent geese, redshank, bar-tailed godwit and curlew are more 'nervous' than oyster catcher, turnstone and dunlin. Turnstones will often tolerate one person within 5-10m. However, one person on a tidal flat can cause birds to stop feeding or fly off affecting c. 5 ha for gulls, c.13 ha for dunlin, and up to 50 ha for curlew (Smit & Visser, 1993). Goss-Custard & Verboven (1993) report that 20 evenly spaced people could prevent curlew feeding over 1000 ha of estuary. Industrial and urban development may
Visual disturbance	

	exclude shy species from adjacent tidal flats. Disturbance causes birds to fly away, increasing energy demand and feeding on the flats later or cause them to move to alternative sites. Least human disturbance is likely in winter, however during breeding period for some species and moulting periods of northerly breeding species in late summer and early autumn most recreational activity takes place. Removal of predators may allow some species to dominate, enable recruitment of others and affect the community structure. However, visual or noise disturbance is unlikely to affect epibenthic or infaunal species, therefore although wildfowl may be regarded as highly intolerant, and overall assessment of intermediate is given. Recovery of birds population may be immediate for some species, while shy species may find more isolated sites.
Introduction or spread of non-indigenous species.	Introduction of North American cord grass *Spartina alterniflora* to stabilize and reclaim high intertidal mudflats has significantly altered UK saltmarsh. *Spartina alterniflora* hybridized with native *Spartina maritima* producing an infertile hybrid (*Spartina townsendii*) which gave rise to fertile *Spartina anglica*. *Spartina anglica* is fast growing and aggressive and has colonized extensive areas of intertidal mudflats, increasing the area of saltmarsh in the UK but reducing intertidal feeding grounds for shorebirds. The success of *Spartina anglica* may dominate the community to the detriment of other species reducing species richness (Eno et al. 1997).
Introduction of microbial pathogens	Although pathogens of *Spartina anglica* are known they have not been implicated in die backs. No information on pathogens of other important species was found.
Removal of target habitat Removal of non-target habitat	Removal of the substratum will remove the vegetation and infauna. Recovery will be dependant on recruitment. Pioneer species such as *Salicornia* sp. and *Aster tripolium* are likely to recover quickly whereas *Spartina* sp. will depend on transport of plant fragments and seed. Infaunal recovery will be dependant on recruitment form neighbouring intertidal populations and may take up to 5 years depending on the species, although mobile species will colonize quickly (e.g. ca I year).

2.4	Cold Water Reefs COR.Lop
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	*Lophelia pertusa* is found in water between 4 and 12°C (Rogers, 1999; Roberts et al., 2003) but records from the Mediterranean suggest it can survive up to 13°C (Mortensen, 2001). In fjords the upper limit of the *Lophelia* reefs coincides with the level of the thermocline. Rogers (1999) suggested that death of the coral on the upper reaches of the reef may reflect changes in the depth of the thermocline. But the upper limit of the *Lophelia* reefs may be attributed to other factors, e.g. the origin of the water masses, salinity, wave action, or competition with other species e.g. sponges (Frederiksen et al., 1992; Rogers, 1999; Mortensen et al., 2001 ; Dr Alex Rogers, pers comm.). The requirement of *Lophelia* for oceanic waters suggested that *Lophelia* was probably intolerant of salinity and temperature change (Rogers, 1999). *Lophelia pertusa* was reported on single point moorings of the Beryl Alpha platform between depths of 75 and 114 m (Roberts, 2002a). The water column around the platform was stratified; the salinity varied from 34.8 ppt at the surface to just over 35 ppt at 50 m, while the surface temperature remained fairly constant at 11.5°C to a depth of 50 m before dropping rapidly to 8°C between 70 and 110 m (Roberts, 2002a). Roberts (2002a) noted that the depth of *Lophelia* corresponded with 8°C and a salinity of 35 ppt. He suggested that *Lophelia* was restricted to depths of greater than 70 m by the temperature and salinity , competition from other epifauna (e.g. sponges and sea anemones) and possibly by wave action during storms (Roberts, 2002a). Offshore, deep-water *Lophelia* reefs are probably isolated from naturally occurring rapid acute changes in temperature due to their depth. But they are probably intolerant of an increase in temperature at the benchmark level caused by an activity that increases temperatures in their locality, e.g. from thermal discharges. The long term effects of climate change on deep -water currents could have far ranging effects (see water flow above). Therefore, an intolerance of high has been recorded. Death of the coral polyps themselves would not immediately result in loss of the reef and the associated species. The associated species, especially epifauna would be lost over a period of years as the coral matrix was slowly eroded to coral rubble and eventually sediment. Although *Lophelia* may be able to colonize the substratum in the meantime, it would still take many years to replace the original reef (see additional information below).
Temperature changes - local decrease	*Lophelia pertusa* is found in water between 4 and 12°C (Rogers, 1999). Rogers (1999) noted that *Lophelia* is not usually found in waters colder than 6°C but that it may encounter lower temperatures at the lower limits of its depth range. In a recent study, Roberts et al. (2003) noted a strong correlation between the occurrence of *Lophelia* and temperature. With a single exception, *Lophelia* had not been recorded in waters colder than 4°C and was absent from depths of greater than 500 m in the Faeroe-Shetland Channel, presumably due to the influence of cold Nordic waters (e.g. the Arctic Intermediate Water and/ or Norwegian Sea Arctic Water with temperatures of 1-5°C or -0.5 to 0.5°C respectively) (Roberts et al., 2003). The only record of *Lophelia* in the Faeroe-Shetland Channel below 500 m occurred in an area subject to temperatures below 4°C for 52% of a 10 month period of observations and below zero for 4% of the same period. Roberts et al. (2003) suggested that the above record probably represented the limit of this *Lophelia pertusa*'s range but that present evidence suggested that seabed mounds

	associated with coral growth were unlikely at depths influenced by cold Nordic waters. Offshore *Lophelia* reefs are probably isolated from naturally occurring rapid acute changes in temperature due to their depth but are probably intolerant of a decrease in temperature at the benchmark level. Any activity or event that changed the circulation of deep-water currents (e.g. climate change) could have wide ranging effects. Therefore, an intolerance of high has been recorded. Death of the coral polyps themselves would not immediately result in loss of the reef and the associated species. The associated species, especially epifauna would be lost over a period of years as the coral matrix was slowly eroded to coral rubble and eventually sediment. Although *Lophelia* may be able to colonize the substratum in the meantime, it would still take many years to replace the original reef (see additional information below).
Salinity changes - local increase	*Lophelia pertusa* occurs in waters of 35 -37 psu but in fjords tolerates salinities as low as 32 psu (Rogers, 1999; Mortensen et al., 2001). However, Rogers (1999) regarded *Lophelia* to be stenohaline. The *Lophelia* reef and its associated fauna occur in relatively stable waters, that are not subject to fluctuations in salinity. While *Lophelia* is probably highly intolerant of changes in salinity at the benchmark level, it is unlikely to experience an increase in salinity except is rare cases such as the unlikely production of hypersaline effluents by offshore installations. Therefore, not relevant has been recorded.
Water flow (tidal current) changes - local increase	Strong current flow appears to be required for growth in *Lophelia*, which occurs in areas of strong water flow. *Lophelia* reefs occur where the topography causes current acceleration, e.g. on raised seabed features (e.g. seamounts and banks) and where the channel narrows in Norwegian fjords (Rogers, 1999). Frederiksen et al. (1992) suggested that topographical highs create internal waves, depending on slope, that resuspended organic particulates from the seabed, and increase the flux of nutrient-rich waters to the surface waters increasing phytoplankton productivity; both effects resulting in increased food availability for *Lophelia* and other suspension feeders. Water flow is important for suspension feeders and passive carnivores, such as *Lophelia*, to provide adequate food, oxygen and nutrients, to remove waste products and prevent sedimentation but the optimum current speed varies with species (see Hiscock, 1983 for discussion). For example, Mortensen (2001) observed no polyp mortality in the vicinity of his aquaria inlets but high mortality at the opposite end. Similarly, the death of coral polyps within a coral coppice is thought to be due to reduced water flow within the colony (Wilson, 1979b). Mortensen (2001) also noted that high current flow (greater than ca 0.05 m/s) was detrimental to growth, presumably due to reduced food capture rates. Frederiksen et al. (1992) suggested that *Lophelia* reefs around the Lousy and Hatton Banks would typically encounter currents speeds of 0.01-0.1 m/s. Water flow rates >0.4 m/s were recorded by moored and landed deployed current meters close to deep-water coral mounds in the Porcupine Seabight (White , 2001 cited in Grehan et al., 2003), while Masson et al. (2003) recorded a maximum residual bottom water flow of 0.35 m/s over a 20 day period in July 2000 over the Darwin Mounds. The mass movement of water and food availability may be of greater importance than current speed alone. Currents speeds of 0.01 -0.1 m/s, 0.35 or 0.4 m/s approximate to between weak and moderately strong water flow. However, oceanic and tidal currents in the region of the Faroes were reported to be about 0.5 m/s (moderately strong) and in the region of west Shetland 0.5 -0.7 m/s or more (moderately strong). Although this species occurs in areas subject to moderately strong current and mass water movement, Mortensen's data (2001) suggests that increased flow may reduce growth. Therefore, an increase in water flow from moderately strong or strong to very strong for a year may depress growth due to reduced feeding efficiency. But, given the long-lived nature of *Lophelia* colonies, an

	increase in water flow for one year is probably tolerable and an intolerance of low has been recorded, albeit with low confidence. Other epifaunal species may be swept away in very strong water flow although the *Lophelia* coral matrix would probably provide a refuge, however, some species may be lost and species richness decline.
Water flow (tidal current) changes - local decrease	Strong current flow appears to be required for growth in *Lophelia*, which occurs in areas of strong water flow. *Lophelia* reefs occur where the topography causes current acceleration, e.g. on raised seabed features (e.g. seamounts and banks) and where the channel narrows in Norwegian fjords (Rogers, 1999). Frederiksen et al. (1992) suggested that topographical highs create internal waves, depending on slope, that resuspended organic particulates from the seabed, and increase the flux of nutrient-rich waters to the surface waters increasing phytoplankton productivity; both effects resulting in increased food availability for *Lophelia* and other suspension feeders. Water flow is important for suspension feeders, such as *Lophelia*, to provide adequate food, oxygen and nutrients, to remove waste products and prevent sedimentation but the optimum current speed varies with species (see Hiscock, 1983 for discussion). For example, Mortensen (2001) observed no polyp mortality in the vicinity of his aquaria inlets but high mortality at the opposite end. Similarly, the death of coral polyps within a coral coppice is thought to be due to reduced water flow within the colony (Wilson 1979b). Therefore, a decrease in water flow from e.g. moderately strong to negligible for a year would probably result in death of at least a proportion of the coral polyps, depending on their position within the reef, i.e. polyps within the coral matrix would be more intolerant of. Other suspension feeding invertebrates would also be adversely affected. Decreased water flow would also result in a increase in siltation, potentially resulting in smothering of *Lophelia* and other suspension feeders, and potentially interfering with *Lophelia* recruitment (Rogers, 1999). Although, a change for a year (see benchmark) is probably only a short period of time in the life of a *Lophelia* colony, Mortensen (2001) observed polyp mortality within a short 2.5 yr. experiment. Therefore, an intolerance of intermediate has been recorded, albeit at low confidence. Recovery would probably take considerable time.
Emergence regime changes - local increase	*Lophelia* reefs occur in oceanic waters, at depths of over 200 m, except in Norwegian fjords where it upper depth limit may be 50 m, below the influence of coastal waters. Therefore, it is unlikely to be affected by changes in the emergence regime and not relevant has been recorded.
Emergence regime changes - local decrease	*Lophelia* reefs occur in oceanic waters, at depths of over 200 m, except in Norwegian fjords where it upper depth limit may be 50 m, below the influence of coastal waters. Therefore, it is unlikely to be affected by changes in the emergence regime and not relevant has been recorded.
Wave exposure changes - local increase	Offshore *Lophelia* reefs occur, by definition, in extremely wave exposed conditions, although wave action is ameliorated by depth. Draper (1967) noted that wave periods in offshore areas are generally of longer than in enclosed seas and therefore penetrate to greater depths. However, Draper (1967) estimated that as far out as the continental shelf, for one day a year, storm conditions could generate a oscillatory water movement on the seabed of only ca 0.4 m/s at 180 m. In Norwegian fjords where *Lophelia* reefs occur as shallow as 50 m, wave action is slight at the surface and most likely does not penetrate more than a few tens of metres. Inner fjords have limited fetch so that wave action is unlikely to penetrate to more than a few tens of metres even in storm conditions (Dr Keith Hiscock pers. comm.). The oscillatory water

	movement generated by wave action could potentially result in fragmentation of branching coral skeletons at the upper limit of their depth distribution, although their skeletons are fairly robust. Occasional fragmentation may not unduly affect the reef but allow it to spread in the long term as the fragments continue to grow, or provide a substratum for colonization by *Lophelia* larvae. However, *Lophelia* occurs at depths at which even the wave action generated by storm conditions is unlikely to penetrate. Therefore, not relevant has been recorded.
Wave exposure changes - local decrease	In shallow, fjordic, examples of the biotope a decrease in wave action may allow the *Lophelia* reef to increase in height. The prevailing oceanic or tidal currents are probably far more important sources of water movement in areas occupied by *Lophelia* reefs than wave action alone. Therefore, a decrease in wave action is unlikely to have any detrimental effects and not sensitive has been recorded.
Water clarity increase	Offshore *Lophelia* reefs occur at considerable depth, below the photic zones of the temperate oceans, and hence in perpetual darkness. A decrease in the turbidity of surface or deeper waters in unlikely to affect offshore reefs since light will still not penetrate to the depth occupied by *Lophelia* reefs. However, a decrease in turbidity may allow algae to colonize shallow *Lophelia* reefs in fjords, increasing competition for space with other suspension feeders and coral larvae, and potentially smothering the coral at its upper limit. Therefore, deep-water *Lophelia* reefs are probably not sensitive to a decrease in turbidity, while shallow water examples may be degraded, and an overall intolerance of intermediate has been recorded. Recovery would take many years (see additional information below).
Water clarity decrease	Offshore *Lophelia* reefs occur at considerable depth, below the photic zones of the temperate oceans, and hence in perpetual darkness. An increase in turbidity at the surface may decrease phytoplankton productivity. However, *Lophelia* and its associated suspension feeders utilize other sources of organic particulates and are unlikely to be significantly affected. *Lophelia* reefs may also occur at about 50 m in fjords, where an increase in turbidity may further inhibit algal growth, although the effects are unlikely to be significant. Therefore, not sensitive has been recorded.
Nutrient enrichment	No information concerning the effects of radioactive contamination on *Lophelia* was found. However, Hall-Spencer et al. (2002) noted that although all shallow water organisms had accumulated nuclear bomb test related ^{14}C, the *Lophelia* specimens collected from deep-waters off west Ireland were not contaminated by anthropogenic ^{14}C, presumably because the water bodies they occupy are ancient. Therefore, *Lophelia* at sites in west Ireland could provide a useful background or baseline level for studies of radioactive contamination.
Habitat structure changes - removal of substratum (extraction)	*Lophelia pertusa* occurs in waters of 35 -37 psu but in fjords tolerates salinities as low as 32 psu (Rogers, 1999; Mortensen et al., 2001). However, Rogers (1999) regarded *Lophelia* to be stenohaline. The *Lophelia* reef and its associated fauna occur in relatively stable waters, that are not subject to fluctuations in salinity. While *Lophelia* is probably highly intolerant of changes in salinity at the benchmark level, it is unlikely to experience an increase in salinity except is rare cases such as the unlikely production of hyposaline effluents by offshore installations. However, in shallow fjordic water *Lophelia* is restricted to the deeper, stable oceanic water below the relatively reduced salinity coastal waters at the surface. An increase in freshwater runoff, may increase the depth of the pycnocline and would probably result in death of the upper extent of the reef. Therefore, an intolerance of intermediate has been recorded. Recovery would probably take several hundred years (see additional information below).

Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	No information concerning the effects of nutrient levels on *Lophelia* and its associated community was found. Removal of the substratum would result in removal of living coral and dead coral debris, resulting in destruction of the reef and loss of the biotope. Therefore an intolerance of high has been recorded. Recovery would probably take several hundreds to thousands of years (see additional information below).
Siltation rate changes	Although *Lophelia* reefs occur a great depths, they are likely to be subject to physical disturbance due to anchorage or positioning of offshore structures on the seabed but especially due to deep-sea trawling. Rogers (1999) suggested that trawling gear would break up the structure of the reef, fragment the reefs, and potentially result in complete disintegration of the coral matrix, and loss of the associated species. Fosså et al. (2002) documented and photographed the damage caused to west Norwegian *Lophelia* reefs by trawling activity (see Fosså, 2003 for photographs). They reported that four, out of five sites studied, contained damaged corals. In the shallow regions of Sørmannsneset, only fragments of dead *Lophelia* were seen, spread around the site with no evidence of living colonies in the surrounding area, and Fosså et al. (2002) concluded that the colonies had been "wiped out". Overall, they estimated that between 30 and 50% of *Lophelia* reefs are either impacted or destroyed by bottom trawling in western Norway. Mechanical damage by fishing gear would also damage or kill the associated epifaunal species, and potentially turn over the coral rubble field, and modify the substratum (Rogers, 1999; Fosså et al., 2002). Fosså et al. (2002) demonstrated that gorgonian (horny) corals were also torn apart by bottom trawling. Fosså (2003) also note that fixed fishing nets, e.g. gill nets, and long-line fisheries and their associated anchors could potentially result in damage to the reefs such as breakage of the coral colonies. However, damage by long-line or gill net fisheries is probably of limited extent compared to bottom trawling (Fosså, 2003). Hall-Spencer et al. (2002) also provided photographic evidence of an area of reef impacted by bottom trawling, with a clearly visible trench (5-10 cm deep) made by otter boards surrounded by smashed coral fragments in west Norway. Hall-Spencer et al. (2002) also noted that otter trawling with rockhopper gear damaged coral habitats in west Ireland, based on analysis of by-catch but also noted that fishing vessels actively avoided rough ground and that the majority of trawls did not result in *Lophelia* by-catch. Koslow et al. (2001) reported that on shallow, heavily fished seamounts off Tasmania, trawling had effectively removed the dominant cold-water coral and its associated fauna. The substratum of heavily fished seamounts was primarily bare rock or coral rubble and sand, features not seen on any lightly fished or un-fished seamount. The abundance and richness of benthic fauna was also "markedly reduced" on heavily fished seamounts (Koslow et al. (2001). Overall, there is significant evidence of damage to *Lophelia* and other cold-water coral reefs due to deep-sea trawling, and an overall intolerance of high has been recorded. Recovery would probably take several hundreds to thousands of years (see additional information below).
	Rogers (1999) suggested that *Lophelia pertusa* would be intolerant of increased rates of sedimentation (siltation), caused by decreased water flow, or the resuspension and subsequent sedimentation of sediment by marine activities, such as offshore construction or mobile fishing gear (e.g. beam or otter trawls), or the discharge of drill cuttings. Corals are generally thought to be intolerant of increases in sedimentation which is thought to be one of largest sources of degradation of coral reefs (Norse, 1993) and may suppress

	the growth rates of colonies (Fosså et al., 2002). Rogers (1999) suggested that sedimentation rates of >10 mg/cm²/day in shallow water coral reefs were high. Smothered polyps would be expected to starve. Mortensen (2001) reported that 25-100% of polyps died after being starved for 3 months or more but in some cases polyps survived starvation for 16 and 20 months. Preliminary results suggest that sand deposition rates of 0.1 mg/cm²/min significantly reduced polyp expansion in *Lophelia pertusa* (Roberts & Anderson, 2002b), which would reduce feeding and hence growth rates. However, Mortensen (2001) demonstrated that *Lophelia pertusa* was able to remove sediment particles <3 mm within 3-5 min and 3-5 mm particles within ca 15 min due to beating of cilia towards the tips of the tentacles, and reported that the living coenosarc (coral tissue) was always clean of sediment. Earlier studies by Shelton (1980), showed that *Lophelia pertusa* could remove graphite particles within ca 30 sec. Similarly, Reigl (1995) demonstrated that scleractinian corals were able to clean sand from their surface actively when exposed to 200 mg of sand per cm² in a single application clearing 50% of the sand within 1000 min, and all the species studied survived for 6 weeks continuous exposure to 200 mg of sand per cm². Reigl (1995) concluded that corals could cope with considerable amounts of sand deposition. Nevertheless, Rogers (1999) suggested that an increase in sedimentation is likely to interfere with feeding and hence growth, which would alter the balance between growth and bioerosion, potentially resulting in degradation of the reef. In addition, smothering would prevent settlement of larvae and hence recruitment. At the benchmark level (smothering by 5 cm of sediment for a month) the majority of the *Lophelia pertusa* polyps would probably be unaffected due to the size of the colony, which is raised above the seabed. Similarly, most other suspension feeding invertebrates will probably survive for one month, suggesting an overall intolerance of low. Recovery would probably be rapid once the sediment was removed. However, any activity that reduces growth may have detrimental effects on the survival of *Lophelia* colonies and the reef in the long term. *Lophelia* reefs are probably highly intolerant of prolonged or frequent smothering effects.
Underwater noise changes	Increased suspended sediment levels may interfere with feeding in suspension feeders, including *Lophelia pertusa*, and hence growth (see above). Therefore an intolerance of low has been recorded at the benchmark level. Recovery would probably be rapid.
Visual disturbance	*Lophelia* occurs in areas of strong currents, where internal waves and current acceleration provides adequate food supplies in the form of plankton and suspended organic particulates. Therefore, any activity that decreased the level of suspended particulates may reduce the food available to *Lophelia* and other suspension feeders. Rogers (1999) suggested that any interference with feeding and hence growth, may alter the balance between growth and bioerosion, potentially resulting in degradation of the reef. However, at the benchmark level duration of one month, decrease in food availability is likely to have only short term effects. Therefore, an intolerance of low has been recorded. Recovery would probably be rapid.
Introduction or spread of non-indigenous species.	No information on diseases was found. However, the parasitic foraminiferan *Hyrrokkin sarcophaga* was reported growing on polyps of *Lophelia pertusa* in aquaria (Mortensen, 2001). The foraminiferan dissolves a hole in the coral skeleton and invades the polyp. In his aquaria, two *Lophelia* polyps became infested but did not seem to be influenced by the infestation (Mortensen, 2001). Any parasitic infestation is likely to reduce the viability of the host, even if only a few or possibly hundreds of polyps were affected but in the absence of additional evidence no assessment of intolerance has been made.

Introduction of microbial pathogens	No alien or non-native species are known to compete with *Lophelia pertusa* or other cold-water corals.
Removal of target habitat	Extraction of *Lophelia pertusa* colonies from the reef would result in fragmentation of part of the coral, and destruction of parts of the reef structure. Although not directly exploited, indirect removal of the coral as by-catch in bottom trawling has been shown result in damage to cold-water reefs (see physical disturbance above). Destruction of the cold-water reefs resulted in a marked reduction in the species richness of seamounts off Tasmania (Koslow et al., 2001). Reefs are considered to be good fishing places for net and long-line fisheries, and fishermen often set their gear as close as possible to reefs but not on them to avoid damaging their fishing gear. However, the development of larger vessels and more powerful trawls, e.g. rockhopper gear designed to operate on rough stony bottoms, has probably exposed the reefs to increased impacts from fishing (Fosså et al., 2002; Fosså, 2003). For example, the fishery of the continental break targeted Greenland halibut, redfish, and saithe. The orange-roughy is another valuable deep-sea species associated with offshore banks, pinnacles and canyons with strong currents, which are favoured by *Lophelia* (Rogers, 1999). In the UK, monkfish is a major fishery in the vicinity of the *Lophelia* reefs around Rockall (Dr Jason Hall-Spencer, pers comm.). Overall, there is significant evidence of damage to *Lophelia* and other cold-water coral reefs due to deep-sea trawling, and an overall intolerance of high has been recorded. Recovery would probably take several hundreds to thousands of years (see additional information below).
Removal of non-target habitat	*Lophelia pertusa* is found in water between 4 and 12°C (Rogers, 1999; Roberts et al., 2003) but records from the Mediterranean suggest it can survive up to 13°C (Mortensen, 2001). In fjords the upper limit of the *Lophelia* reefs coincides with the level of the thermocline. Rogers (1999) suggested that death of the coral on the upper reaches of the reef may reflect changes in the depth of the thermocline. But the upper limit of the *Lophelia* reefs may be attributed to other factors, e.g. the origin of the water masses, salinity, wave action, or competition with other species e.g. sponges (Frederiksen et al., 1992; Rogers, 1999; Mortensen et al., 2001; Dr Alex Rogers, pers comm.). The requirement of *Lophelia* for oceanic waters suggested that *Lophelia* was probably intolerant of salinity and temperature change (Rogers, 1999). *Lophelia pertusa* was reported on single point moorings of the Beryl Alpha platform between depths of 75 and 114 m (Roberts, 2002a). The water column around the platform was stratified; the salinity varied from 34.8 ppt at the surface to just over 35 ppt at 50 m, while the surface temperature remained fairly constant at 11.5°C to a depth of 50 m before dropping rapidly to 8°C between 70 and 110 m (Roberts, 2002a). Roberts (2002a) noted that the depth of *Lophelia* corresponded with 8°C and a salinity of 35 ppt. He suggested that *Lophelia* was restricted to depths of greater than 70 m by the temperature and salinity, competition from other epifauna (e.g. sponges and sea anemones) and possibly by wave action during storms (Roberts, 2002a). Offshore, deep-water *Lophelia* reefs are probably isolated from naturally occurring rapid acute changes in temperature due to their depth. But they are probably intolerant of an increase in temperature at the benchmark level caused by an activity that increases temperatures in their locality, e.g. from thermal discharges. The long term effects of climate change on deep-water currents could have far ranging effects (see water flow above). Therefore, an intolerance of high has been recorded. Death of the coral polyps themselves would not immediately result in loss of the reef and the associated species. The associated species, especially epifauna would be lost over a period of years as the coral matrix was slowly eroded to coral rubble and eventually

	sediment. Although *Lophelia* may be able to colonize the substratum in the meantime, it would still take many years to replace the original reef (see additional information below).

2.5	Eggwrack beds SLR_AscX_mac
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Chock & Mathieson (1979) found no major physiological difference between the attached form of *Ascophyllum nodosum* and its ecad scorpioides so it seems likely that the mackaii ecad will also be physiologically similar to the attached form. *Ascophyllum nodosum* and the mackaii ecad are intertidal and so are regularly exposed to rapid and short-term variations in temperature. Both exposure at low tide or rising tide on a sun-heated shore may involve considerable temperature increases. Growth has been measured between 2.5 and 35°C with an optimum between 10 and 17°C (Strömgren, 1977). In the North Sea *Ascophyllum nodosum* can tolerate a maximum temperature of 28°C and the optimum growth rate is at 15°C (Lüning, 1990). Laboratory experiments in New Hampshire showed that *Ascophyllum nodosum* exhibits a eurythermal response to temperature with a more pronounced optimum occurring during the summer than the winter (Chock & Mathieson, 1979). Overall, summer plants showed a higher rate of net photosynthesis than winter specimens. Therefore, the species is likely to be quite tolerant of a long term change in temperature of 2°C. The species is unlikely to be affected by a short term change of 5°C, as it was not damaged during the unusually hot summer of 1983 when the average temperature was 8.3°C higher than normal (Hawkins & Hartnoll, 1985). Although some of the associated macrofauna may be more intolerant of increases in temperature they are not key to the structure and function of the biotope. Therefore, the biotope is considered to have low intolerance to increases in temperature. However, the species has been found to be damaged by thermal pollution if the water temperature is above 24°C for several weeks (Lobban & Harrison, 1997) and the southern limit of the species distribution is controlled by the maximum summer temperature of about 22°C (Baardseth, 1970).
Temperature changes - local decrease	In Newfoundland populations of *Ascophyllum nodosum ecad mackaii* are subjected to low temperatures and ice conditions probably seldom encountered in the Scottish and Irish habitats studied by Gibb (1957). In January 1970, some populations were encased in ice, a phenomenon enhanced by the "layering" effect of fresh and salt water in these habitats (South & Hill, 1970). Judging from the age of some of the globular tufts at some of these sites, the authors suggest the plants can presumably withstand a number of successive winters of ice encasement without undue harm. Such conditions during the particularly stormy months of the year could possibly ensure the survival of mackaii in these localities. The extreme sheltered conditions occupied by the ecad, and its free-living habit would preclude it, however, from the severest action of pack ice frequently occurring on the open coast in Newfoundland. Although some other species, such as the gammarid amphipod *Hyale prevostii*, will be more intolerant of long and short term changes in temperature the key species, the ecad, is likely to tolerate such changes and so intolerance is assessed as low. Metabolic and reproductive processes which may be affected by a drop in temperature are likely to return to normal very quickly.
Salinity changes - local increase	The development and maintenance of the ecad depends on the frequent alternation of high and low salinity. These conditions occur between high and low water neaps, in places where freshwater streams have an influence but where there is full marine salinity for a period during the tidal cycle. Therefore, it is expected that a long term increase in salinity would be detrimental to the

	species and hence the biotope and a rank of high is recorded. Information on recovery can be found in 'additional information' below.
Water flow (tidal current) changes - local increase	The biotope occurs in very sheltered locations with weak or very weak tidal streams because the mackaii ecad is unattached. Therefore, the biotope is likely to be highly intolerant of an increase in water flow rate because plants of the characterizing species will be washed away. The attached form and the other fucoid algal species in the biotope are able to tolerate higher water flow rates than the unattached ecad. For recovery see additional information.
Water flow (tidal current) changes - local decrease	The biotope occurs in very sheltered locations where water flow rates may be negligible so a decrease is not relevant.
Emergence regime changes - local increase	*Ascophyllum nodosum* is normally exposed to air for no more than a few hours (Lüning, 1990). An increase in the period of emersion would subject the species to greater desiccation and nutrient stress, leading to a depression in the upper limit of the species distribution on the shore. Other species are also likely to be affected in a similar way so intolerance of the biotope is considered to be intermediate. Where present the ecad can proliferate itself vegetatively from its own broken fragments which continue to divide forming new plants. Therefore, recovery should be possible within five years although it may take longer for plants to return to original density and biomass so a rank of moderate of reported.
Emergence regime changes - local decrease	*Ascophyllum nodosum ecad mackaii* and its component species are all likely to survive increased or full immersion. However, a reduction in the period of emersion may result in the species being competitively displaced by faster growing species and may allow the upper limit of the population of *Ascophyllum nodosum* to extend up the shore.
Wave exposure changes - local increase	The biotope is likely to be highly intolerant of increases in wave exposure because the free living mackaii ecad of *Ascophyllum nodosum* only develops in locations of extreme shelter. Increased wave action could also result in the displacement of plants from ideal conditions. In addition the fauna that shelter in plants are also likely to be displaced if wave action increases. Therefore, the intolerance of the biotope is considered to be high. Recoverability is assessed as low because it is not known if lost beds can recover - see additional information.
Wave exposure changes - local decrease	*Ascophyllum nodosum ecad mackaii* only develops in areas of extreme shelter where wave exposure in negligible so a decrease in wave exposure at the level of the benchmark is not relevant.
Water clarity increase	A decrease in turbidity would increase the light available for photosynthesis during immersion which may increase growth rates of all the algae in the biotope. Upon return to previous turbidity levels the photosynthesis rate would return immediately to normal.
Water clarity decrease	An increase in turbidity would reduce the light available for photosynthesis during immersion. However, the species is found at the upper and mid-tide levels and so is subject to long periods of emersion during which time it can continue to photosynthesize as long as the plant has a sufficiently high water content. Therefore, photosynthesis and consequently growth will be unaffected during this period and so intolerance of the species, and hence the biotope, is considered to be low. Upon return to previous turbidity levels the photosynthesis rate would return immediately to normal.

Nutrient enrichment	Although the mackaii ecad of *Ascophyllum nodosum* is unattached the species is likely to be removed along with substratum removal. Other key or characterizing species in the biotope will also be removed and so intolerance is considered to be high. For recoverability see additional information.
Habitat structure changes - removal of substratum (extraction)	Frond injury in the mackaii ecad is common and often severe and plays an important part in the life of plants (Gibb, 1957). Injury influences the branching of the plant by acting as a stimulus for the development of lateral branches. Therefore, the plants are likely to have low intolerance to abrasion. However, a passing scallop dredge, or similar impact, is likely to physically remove a number of the plants themselves, similar to but not as extensive as substratum loss above. Therefore, an intolerance of intermediate has been recorded. Where present, the ecad can proliferate itself vegetatively from its own broken fragments which continue to divide forming new plants. Therefore, recovery should be possible within five years although it may take longer for plants to return to original density and biomass so a score of moderate of reported.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	The key species, *Ascophyllum nodosum ecad mackaii*, is likely to be intolerant of smothering by 5 cm of sediment because photosynthesis would not be possible and plants would also be likely to rot underneath the smothering material. The habitats in which the ecad is found are very sheltered from wave exposure and tidal streams so sediment is unlikely to be removed by water movement. However, some component species such as amphipods and snails may excavate out of the sediment. Thus, because the key characterizing species is lost the biotope will also be lost if smothered and so is considered to be highly intolerant. The small embayments and inlets, often enclosed by rocky headlands, the typical habitat for *Ascophyllum nodosum ecad mackaii*, are vulnerable to infilling for land-based deposits for marine industries such as fish and shellfish farms, slipways, car parks and other developments (Anonymous, 1999(t)). For recoverability see additional information.
Siltation rate changes	*Ascophyllum nodosum ecad mackaii* is not likely to be directly intolerant of an increase in suspended sediment because although turbidity will increase, photosynthesis can still occur when the tide is out (see turbidity). However, settlement out of the sediment may cover some surfaces of the plant, reducing photosynthesis rates which may reduce growth. Other species in the biotope, in particular the suspension feeders, such as *Lanice conchilega*, are likely to be more intolerant because an increase in suspended sediment may interfere with feeding, increase cleaning costs and result in lower growth rates. However, the impact on the biotope as a whole will be negligible so intolerance has been assessed as low. On return to pre-impact suspended sediment levels feeding rates of affected species and photosynthetic rates will return to normal very rapidly.
	Ascophyllum nodosum ecad mackaii is not likely to be directly intolerant of a decrease in suspended sediment because the species is a primary producer. Other species in the biotope, in particular the suspension feeders, such as *Lanice conchilega*, are likely to be more intolerant because a decrease in suspended sediment may also result in a decrease in food supplies so growth may be affected. However, the impact on the biotope as a whole will be negligible so intolerance has been assessed as low. On return to pre-impact suspended sediment levels feeding of affected species and photosynthetic rates will return to normal very rapidly.
	Although bacteria and fungi are associated with the attached form of *Ascophyllum nodosum* no information could be found on any disease causing microbes in the biotope and so intolerance is assessed as low. However, there is always the potential for this to change.

Underwater noise changes	There are no records of any non-native species invading the biotope that may compete with or graze upon *Ascophyllum nodosum ecad mackaii* and so the biotope is assessed as not sensitive. However, as several species have become established in British waters there is always the potential for an adverse effect to occur.
Visual disturbance	The attached form of *Ascophyllum nodosum* is still collected on a small scale in western Scotland for the extraction of alginate. The unattached mackaii ecad is very easy to collect as it does not need cutting from the rock and it has been collected along with the attached form in the past. For example, *Ascophyllum nodosum ecad mackaii* beds and associated communities in the Uists in the Outer Hebrides have been decimated by removal of plants. *Littorina littorea* is also harvested by hand, without regulation, for human consumption. In some areas, notably Ireland, collectors have noted a reduction in the number of large snails available. It is likely that at least part of the population of either of these two species may be lost and accordingly, intolerance has been assessed as intermediate. It is not known if it is possible, or how long it takes, for beds of *Ascophyllum nodosum ecad mackaii* to recover from harvesting. For example, there was no sign of recovery of a bed two years after its removal at Kyle of Lochalsh (Anonymous, 1999(t)). However, once present the ecad can proliferate itself vegetatively from its own broken fragments which continue to divide forming new plants. Therefore, recovery should be possible within five years although it may take longer for plants to return to original density and biomass so a rank of moderate of reported.
Introduction or spread of non-indigenous species.	Chock & Mathieson (1979) found no major physiological difference between the attached form of *Ascophyllum nodosum* and its ecad scorpioides so it seems likely that the mackaii ecad will also be physiologically similar to the attached form. *Ascophyllum nodosum* and the mackaii ecad are intertidal and so are regularly exposed to rapid and short-term variations in temperature. Both exposure at low tide or rising tide on a sun-heated shore may involve considerable temperature increases. Growth has been measured between 2.5 and 35°C with an optimum between 10 and 17°C (Strömgren, 1977). In the North Sea *Ascophyllum nodosum* can tolerate a maximum temperature of 28°C and the optimum growth rate is at 15°C (Lüning, 1990). Laboratory experiments in New Hampshire showed that *Ascophyllum nodosum* exhibits a eurythermal response to temperature with a more pronounced optimum occurring during the summer than the winter (Chock & Mathieson, 1979). Overall, summer plants showed a higher rate of net photosynthesis than winter specimens. Therefore, the species is likely to be quite tolerant of a long term change in temperature of 2°C. The species is unlikely to be affected by a short term change of 5°C, as it was not damaged during the unusually hot summer of 1983 when the average temperature was 8.3°C higher than normal (Hawkins & Hartnoll, 1985). Although some of the associated macrofauna may be more intolerant of increases in temperature they are not key to the structure and function of the biotope. Therefore, the biotope is considered to have low intolerance to increases in temperature. However, the species has been found to be damaged by thermal pollution if the water temperature is above 24°C for several weeks (Lobban & Harrison, 1997) and the southern limit of the species distribution is controlled by the maximum summer temperature of about 22°C (Baardseth, 1970).
Introduction of microbial pathogens	In Newfoundland populations of *Ascophyllum nodosum ecad mackaii* are subjected to low temperatures and ice conditions probably seldom encountered in the Scottish and Irish habitats studied by Gibb (1957). In January 1970, some populations were encased in ice, a phenomenon enhanced by the "layering" effect of fresh and salt water in these habitats

	(South & Hill, 1970). Judging from the age of some of the globular tufts at some of these sites, the authors suggest the plants can presumably withstand a number of successive winters of ice encasement without undue harm. Such conditions during the particularly stormy months of the year could possibly ensure the survival of mackaii in these localities. The extreme sheltered conditions occupied by the ecad, and its free-living habit would preclude it, however, from the severest action of pack ice frequently occurring on the open coast in Newfoundland. Although some other species, such as the gammarid amphipod *Hyale prevostii*, will be more intolerant of long and short term changes in temperature the key species, the ecad, is likely to tolerate such changes and so intolerance is assessed as low. Metabolic and reproductive processes which may be affected by a drop in temperature are likely to return to normal very quickly.
Removal of target habitat	The development and maintenance of the ecad depends on the frequent alternation of high and low salinity. These conditions occur between high and low water neaps, in places where freshwater streams have an influence but where there is full marine salinity for a period during the tidal cycle. Therefore, it is expected that a long term increase in salinity would be detrimental to the species and hence the biotope and a rank of high is recorded. Information on recovery can be found in 'additional information' below.
Removal of non-target habitat	The biotope occurs in very sheltered locations with weak or very weak tidal streams because the mackaii ecad is unattached. Therefore, the biotope is likely to be highly intolerant of an increase in water flow rate because plants of the characterizing species will be washed away. The attached form and the other fucoid algal species in the biotope are able to tolerate higher water flow rates than the unattached ecad. For recovery see additional information.

2.6	Estuarine Rocky habitats SIR.Lsac.Pk
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The species characteristic of the biotope are well within the range of temperatures in which they occur geographically and are unlikely to be lost as a result of higher temperatures occurring in the long term. However, exposure to high temperatures for several days may produce stress in some components but recovery would be rapid.
Temperature changes - local decrease	The species characteristic of the biotope are well within the range of temperatures in which they occur geographically and are unlikely to be lost as a result of lower temperatures occurring in the long term. However, exposure to low temperatures for several days may result in some mortality. Records in Crisp (1964) suggest that the species in the biotope are likely to be of low susceptibility to cold although *Psammechinus miliaris* was adversely affected by the 1962/63 winter and *Antedon bifida* is believed to have been lost from the Menai Strait following the 1947 winter (D.J. Crisp pers. comm. to K. Hiscock).
Salinity changes - local increase	The biotope occurs in full salinity conditions and so increase in salinity from variable or low would not adversely affect it.
Water flow (tidal current) changes - local increase	It is unlikely that species in the biotope will be killed by an increase in flow rate. Existing organisms are likely to persist although conditions will not be ideal. A few mobile species such as brittle stars might be swept away. However, in situations where the substratum on which *Saccharina latissima* occurs is of cobbles or pebbles, it is likely that kelp plants might cause sufficient drag for plants and attached organisms to be swept away. In that case, a different biotope is likely to develop.
Water flow (tidal current) changes - local decrease	The biotope exists in areas with very little or no tidal flow.
Emergence regime changes - local increase	The biotope is predominantly sublittoral and the dominant species (*Saccharina latissima*) and many of the subordinate species, especially solitary sea squirts, are unlikely to survive an increased emergence regime. Several mobile species such as sea urchins, brittle stars and feather stars are likely to move away. However, providing that suitable substrata are present, the biotope is likely to re-establish further down the shore within a similar emergence regime to that which existed previously.
Emergence regime changes - local decrease	The biotope is sublittoral and so decrease in emergence is not relevant.
Wave exposure changes - local increase	Several of the species characteristic of the biotope are reported as having high intolerance to synthetic chemicals. For instance, Cole et al. (1999) suggested that herbicides such as Simazine and Atrazine were very toxic to macrophytic algae. Hoare & Hiscock (1974) noted that almost all red algal species and many animal species were absent from Amlwch Bay in North Wales adjacent to an acidified halogenated effluent. Red algae have also

	been found to be sensitive to oil spill dispersants (O'Brien & Dixon, 1976; Grandy quoted in Holt et al. 1995). Recovery is likely to occur fairly rapidly - see Additional Information.
Wave exposure changes - local decrease	Some small amount of wave action is most likely required to prevent stagnation occurring in this biotope. Stagnation would most likely result is some localized de-oxygenation. And some species in sheltered pockets would be lost.
Water clarity increase	The biotope is characterized especially by algae which are likely to increase in downward extent if light penetration increases.
Water clarity decrease	Several of the characteristic species are algae that rely on light for photosynthesis. Decrease in light penetration as a result of higher turbidity is unlikely to be fatal in the short term but in the long term will result in a reduction in downward extent and therefore overall extent of the biotope.
Nutrient enrichment	Most of the species characteristic of this biotope are permanently attached to the substratum and would be removed upon substratum loss. For recoverability, see Additional Information.
Habitat structure changes - removal of substratum (extraction)	*Saccharina latissima*, other algae and the large solitary tunicates are likely to be especially intolerant of physical disturbance and to be removed from the substratum. Sea urchins, brittlestars, and feather stars are likely to be damaged. However, the main species covering rock, encrusting coralline algae, will survive increased abrasion including if cobbles are moved around. Overall, some keystone species are likely to be lost but some will remain and an intolerance of intermediate is suggested. For recoverability, see additional information below.
Heavy abrasion, primarily at the seabed surface	Some species, especially *Saccharina latissima*, are likely to protrude above smothering material whilst some, such as *Lithophyllum incrustans*, will most likely survive under smothering material. Mobile species such as urchins and brittle stars will be able to migrate out of most smothering material. Others such as the active suspension feeders and low-growing foliose algae are likely to be killed by smothering. However, since keystone species are likely to survive an intolerance of intermediate has been indicated. For recoverability, see Additional Information.
Light abrasion at the surface only	
Siltation rate changes	Increase in suspended sediment is likely to have a significant effect in the low water movement regime in which this biotope lives. Settling silt may smother organisms or clog respiratory and feeding organs (especially sea squirts). However, many of the species in this biotope live in areas of high silt content and may be able to survive. For effects on light penetration, see turbidity. For recoverability, see Additional Information.
	Decrease in suspended sediment levels is not likely to have a significant effect on this biotope although suspension and deposit feeders that gain nutrients from silt may be adversely affected. On the other hand, suspension feeders may be less affected by clogging by silt. For effects on light penetration, see turbidity.
	Macrophytes have no known visual sensors. Most macroinvertebrates have poor or short range perception and are unlikely to be affected by visual disturbance such as shading.
Underwater noise changes	Macrophytes have no known visual sensors. Most macroinvertebrates have poor or short range perception and are unlikely to be affected by visual disturbance such as shading.
Visual disturbance	There is little information on microbial pathogen effects on the characterizing species in this biotope. However, *Saccharina latissima* may be infected by the microscopic brown alga *Streblonema aecidioides*. Infected algae show

	symptoms of Streblonema disease, i.e. alter ations of th e blade an d stipe ranging from dark spots to heavy deformations and completely crippled thalli (Peters & Scaffelke, 19 96). Infection can reduce growth rat es of host algae. *Echinus esculentus* is susceptible to 'Bald-sea-urchin disease', which causes lesions, loss of spines, tube feet, pedicellariae, destruction of the upper layer of skeletal tissue and death. It is thought to be caused by the bacteria *Vibrio anguillarum* and *Aeromonas salmonicida*. Bald sea-urchin disease was recorded fr om *Echinus esculentus* on the Brittany Coast. Although associated with mass mortalities of *Strongylocentrotus franciscanus* in California a nd *Paracentrotus lividus* in the Fr ench Mediterranean it is not known if the disease induces mass mortality (Bower 19 96). However, no evidence of mass mortalities of *Echinus esculentus* associated with disease have been recorded in Britain and Ireland . It is likely that microbial pathogens will have only a minor possible impact on this biotope.
Introduction or spread of non-indigenous species.	This assessment of in tolerance relates to known non-n ative species in October 2001. Although non-native species may colonize the biotope the y are unlikely to significantly displace or affect native species.
Introduction of microbial pathogens	Extraction of *Saccharina latissima* may occur but the p lant rapidly colonizes cleared are as of the substratum: Kain (1975) recorded t hat *Saccharina latissima* (studied as La minaria saccharina) wa s abundant six months after the substratum was cleared so recovery should be rapid. Associated species are unlike ly to be affe cted by re moval of *Saccharina latissima* unless protection f rom desiccation on th e lower sh ore is imp ortant. *Echinus esculentus* may also be colle cted. The collection of *Echinus esculentus* for the curio trade was studied by Nichols (198 4). He concluded that the majority of divers colle cted only la rge specimens that are seen quickly and often misse d individual s covered b y seaweed or under rocks, e specially if small. As a result, a significant pr oportion of the population remains. An intermediate intolerance has been suggested t o reflect the possibility that either of these two species may exp erience some loss. Given the majority of each is likely to remain however, recovery has been assessed as high.
Removal of target habitat	The specie s characteristic of the biotope ar e well within the range of temperatures in which t hey occur geographically and are unlikely to be lost as a resu lt of higher t emperatures occurr ing in the long term. Howeve r, exposure to high temperatures for several days may produc e stress in some components but recovery would be rapid.
Removal of non-target habitat	The specie s characteristic of the biotope ar e well within the range of temperatures in which t hey occur geographically and are unlikely to be lost as a result of lower temperatures occurring in the long term. Ho wever, exposure to low temperatures for several days may result in some mortality. Records in Crisp (1964) suggest tha t the species in the biotope are likely to be of low susceptib ility to cold although *Psammechinus miliaris* was adversely af fected by th e 1962/63 winter and *Antedon bifida* is believed to have been lost from the Menai Strait following t he 1947 winter (D.J. Crisp pers. comm. to K. Hiscock).

2.6	Estuarine Rocky Habitats SIR.Lsac.RS
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The biotope occurs as different sub-biotopes in warmer and colder parts of Britain and Ireland and it might be that northern elements would be adversely affected and, in the long-term, northern version of the biotope may be lost. However, exposure to high temperatures for several days may produce stress in some component species but not mortality and recovery would be expected to be rapid. An intolerance of low is therefore indicated and a recoverability of very high.
Temperature changes - local decrease	The biotope occurs in warmer and colder parts of Britain and Ireland as different sub-biotopes. Similar assemblages of species are known to occur in Scandinavia so that long-term decrease in temperature is unlikely to cause a significant impact on the northern sub-biotopes but may adversely affect the southern form. However, exposure to low temperatures for several days may produce stress in some component species but recovery would be expected to be rapid. An intolerance of low is therefore indicated and a recoverability of very high.
Salinity changes - local increase	The biotope is typically found in areas subject to reduced or low salinity. It is most likely that, with an increase in salinity, the biotope will change to another one, possibly SIR.Lsac.Pk or SIR.Lsac.Cod and *Saccharina latissima* might be joined by Laminaria digitata so that the biotope becomes SIR.Lsac.Ldig. Change to another biotope means that SIR.LsacRS is lost and so intolerance is high. Species richness might increase as low salinity ceases to be an adverse factor. Species that replace those characteristic of SIR.LsacRS may persist for some time and delay recovery of the original biotope but recoverability is still considered likely to be high (see additional information below).
Water flow (tidal current) changes - local increase	Increase in tidal flow rates may dislodge substrata (especially where large plants of *Saccharina latissima* subject to drag are attached to cobbles). Also, increased water flow rate may result in certain species being unable to feed when water flow is likely to damage feeding organs (see Hiscock 1983). However, it is unlikely that species attached to non-mobile substrata in the biotope will be killed by an increase in flow rate. Therefore a decline in the abundance of some species that are swept away is suggested with some reduction in viability of others depending on whether the current velocity reaches a high enough level to inhibit feeding. An intolerance of intermediate has been recorded with a recoverability of high (see additional information below).
Water flow (tidal current) changes - local decrease	The biotope occurs in areas of weak or very weak tidal flow and a further decrease may adversely affect the biotope through the onset of stagnation and consequent deoxygenation as well as siltation and smothering. However, some species in the biotope are active suspension feeders (sponges, solitary ascidians) that are known to thrive in extremely sheltered locations (see, for instance, Hiscock & Hoare, 1973) or at least survive in such situations (barnacles). Therefore, there may be some localized mortality but all-in-all, the biotope is likely to survive. An intolerance of low is therefore indicated and a recovery of very high.

Emergence regime changes - local increase	The biotope is predominantly sublittoral and the dominant species (*Saccharina latissima*) and many of the subordinate species, especially foliose algae and solitary sea squirts, are unlikely to survive an increased emergence regime. Several mobile species are likely to move away. However, providing that suitable substrata are present, the biotope is likely to re-establish further down the shore within a similar emergence regime to that which existed previously (see additional information below). An intolerance of high and a recoverability of high is therefore indicated.
Emergence regime changes - local decrease	The biotope is subtidal and thrives in fully submerged conditions.
Wave exposure changes - local increase	This is a fundamentally sheltered coast biotope with species that does not appear to occur in wave exposed situations. Increased wave action is likely to dislodge *Saccharina latissima* plants and interfere with feeding in solitary tunicates. Massive growths of *Halichondria panicea* are likely to be displaced. Although 'major decline' is indicated with regard to species richness, the results of increased wave exposure would be replacement of biotope-characteristic species with others and the development of a different biotope. A change of biotope means high intolerance. On return to previous conditions, the 'new' biotope would have to degrade before SIR.LSacRS developed. Nevertheless, such a change should occur within five years and a recoverability of high is indicated (see additional information below).
Wave exposure changes - local decrease	This biotope occurs in locations not subject to any significant wave exposure so that decrease in wave exposure is considered not relevant.
Water clarity increase	Decreased turbidity and the subsequent increase in light levels is likely to result in an extension of the downward extent of the biotope. Not sensitive* is therefore indicated.
Water clarity decrease	Several of the characteristic species are algae that rely on light for photosynthesis. Reduction in light penetration as a result of higher turbidity is unlikely to be fatal to algae in the short term but in the long term will result in a reduction in downward extent and therefore overall extent of the biotope. Species richness may decline in the long-term as algae are unable to survive high turbidity and low light but reduced extent of the biotope (depth limits) is the most significant likely decline. An intolerance of intermediate will apply and recoverability will be high (see additional information below).
Habitat structure changes - removal of substratum (extraction)	Most of the species characteristic of this biotope are permanently or firmly attached to the substratum so would be removed upon substratum loss. Intolerance is therefore high. Recovery would be likely within a few years and by five years the biotope is likely to appear as before the impact (see additional information below).
Heavy abrasion, primarily at the seabed surface	*Saccharina latissima*, other algae, sponges and the large solitary tunicates are likely to be removed from the substratum by physical disturbance and sea urchins may be crushed. Physical disturbance will also overturn boulders and cobbles so that the epibiota becomes buried. Mortality of species is therefore likely to be high although many, particularly mobile

Light abrasion at the surface only	species, will survive. An intolerance of high is therefore indicated. Recoverability is expected to be high (see additional information below).
Siltation rate changes	Some species, especially *Saccharina latissima*, are likely to protrude above smothering material. Others such as the active suspension feeders and foliose algae are likely to be killed by smothering. An intolerance of intermediate is suggested as some individuals might die but the biotope will persist and recoverability will be high (see additional information below). However, if smothering is in the form of impermeable material, intolerance will be high.
	Increased suspended sediment levels will reduce the amount of light reaching the seabed and may therefore inhibit photosynthesis of the algal component of the biotope (see increase in turbidity below). However, the biotope occurs in very shallow depths and algae are likely to survive . Suspended silt may clog respiratory and feeding organs (especially of sea squirts). However, since many of the species in this biotope live in areas of high silt content (turbid water) it is expected that they would survive increased levels of silt in the water. Both algae and animals would suffer some decrease in viability. On return to lower suspended sediment levels it is expected that recovery of condition will be rapid. Therefore an intolerance of low and recoverability of very high is indicated.
	Decreased suspended sediment levels will increase the amount of light reaching the seabed and may therefore increase competitiveness of the algal component of the biotope (see decrease in turbidity below). Suspended sediment may include organic matter and a decrease may reduce the amount of food available to suspension feeding animals. Both algae and animals would suffer some decrease in viability. On return to higher suspended sediment levels it is expected that recovery of condition will be rapid. Therefore an intolerance of low and recoverability of very high is indicated.
Introduction or spread of non-indigenous species.	There is little information on microbial pathogen effects on the characterizing species in this biotope. However, *Saccharina latissima* may be infected by the microscopic brown alga *Streblonema aecidioides*. Infected algae show symptoms of Streblonema disease, i.e. alterations of the blade and stipe ranging from dark spots to heavy deformations and completely crippled thalli (Peters & Scaffelke, 1996). Infection can reduce growth rates of host algae. It is likely that microbial pathogens will have only a minor possible impact on this biotope and an intolerance of low has been reported.
Introduction of microbial pathogens	The still water conditions that characterize this biotope suggest that some tolerance of reduced oxygen conditions is likely. Sponges and ascidians produce their own feeding currents and may be important in circulating water. Also, the algae in the biotope produce oxygen. However, any dead material is likely to rot and cause local pockets of de-oxygenation. If the water becomes very still, de-oxygenation might occur and the sort of situation that develops in Abereiddy Quarry (Hiscock & Hoare, 1973) may develop with organisms below a thermocline dying. Cole et al. (1999) suggest possible adverse effects on marine species below 4 mg/l and probable adverse effects below 2mg/l. Whilst there is some tolerance of deoxygenation, some of the species in the biotope may die and so an intolerance of intermediate is suggested. However, on return to oxygenated conditions, rapid recovery of surviving organisms is likely and others will settle readily (see additional information below).

Removal of target habitat	The sub-biotope SIR.LsacRS.Fir which occurs in south-west Britain is colonized by the slipper limpet *Crepidula fornicata* and by the solitary ascidian *Styela clava* at a few locations. *Crepidula fornicata* may be common in some examples of the biotope and is known to smother areas of seabed both by itself and through the pseudofaeces it produces. *Styela clava* occurs in small numbers and occupies little space. *Crepidula* could extend its distribution northwards and may have a significant impact. Another non-native species that might colonize this biotope is *Sargassum muticum* which is generally considered to be a 'gap-filler'. However, it may displace some native species. The biotope does seem to be threatened to some degree by non-native species and an intolerance of high is proposed by with a very low confidence. Recovery would be high (see additional information below).
Removal of non-target habitat	*Psammechinus miliaris* is important as both a characterizing and a key functional species. Extraction of *Psammechinus miliaris* is becoming increasingly more likely to be a factor. An alternative source of the continental delicacy of urchin gonads is sought as other urchin species are declining due to over extraction (e.g. *Paracentrotus lividus*). The aquaculture potential of this smaller species is being investigated (Kelly et al., 1998). Collecting of *Echinus esculentus* for the curio trade was studied by Nichols (1984). He concluded that the majority of divers collected only large specimens that are seen quickly and often missed individuals covered by seaweed or under rocks, especially if small. As a result, a significant proportion of the population remains. He suggested that exploited populations should not be allowed to fall below 0.2 individuals per square metre. Similar principles should apply to *Psammechinus miliaris*. Recruitment to the remaining population will occur by larval settlement from the plankton. Although *Psammechinus miliaris* is quite long lived (up to 12 years) (Allain, 1978), it has immature gonads within a year of settling (Jensen, 1969) and probably breeds the following year. Breeding occurs in spring/early summer each year (Mortensen, 1927; Sukarno et al., 1979) and fecundity is likely to be high (MacBride, 1903) and the larvae are long lived (30-40 days) (Jensen, 1969; Massin, 1999b. Dispersal potential is therefore large. For the sub-biotope SIR.LsacRS.Psa, intolerance to extraction is therefore high as it would be likely to change to a different sub-biotope (probably SIR.Lsac.Phy). However, because intense urchin grazing reduces diversity, extraction may allow for increased species richness. Recoverability is likely to be high (see additional information below).

2.6	**Estuarine Rocky Habitat SLR.AScX.mac**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Chock & Mathieson (1979) found no major physiological difference between the attached form of *Ascophyllum nodosum* and its ecad scorpioides so it seems likely that the mackaii ecad will also be physiologically similar to the attached form. *Ascophyllum nodosum* and the mackaii ecad are inter tidal and so are regularly exposed to rapid and short-term variations in temperature. Both exposure at low tide or rising tide on a sun-heated shore may involve considerable temperature increases. Growth has been measured between 2.5 and 35°C with an optimum between 10 and 17 °C (Strömgren, 1977). In the North Sea *Ascophyllum nodosum* can tolerate a maximum temperature of 28°C and the optimum growth rate is at 15°C (Lüning, 1990). Laboratory experiments in New Hampshire showed that *Ascophyllum nodosum* exhibits a eurythermal response to temperature with a more pronounced optimum occurring during the summer than the winter (Chock & Mathieson, 1979). Overall, summer plants showed a higher rate of net photosynthesis than winter specimens. Therefore, the species is likely to be quite tolerant of a long term change in temperature of 2°C. The species is unlikely to be affected by a short term change of 5°C, as it was not damaged during the unusually hot summer of 1983 when the average temperature was 8.3°C higher than normal (Hawkins & Hartnoll, 1985). Although some of the associated macrofauna may be more intolerant of increases in temperature they are not key to the structure and function of the biotope. Therefore, the biotope is considered to have low intolerance to increases in temperature. However, the species has been found to be damaged by thermal pollution if the water temperature is above 24°C for several weeks (Lobban & Harrison, 1997) and the southern limit of the species distribution is controlled by the maximum summer temperature of about 22°C (Baardseth, 1970).
Temperature changes - local decrease	In Newfoundland populations of *Ascophyllum nodosum* ecad mackaii are subjected to low temperatures and ice conditions probably seldom encountered in the Scottish and Irish habitats studied by Gibb (1957). In January 1970, some populations were encased in ice, a phenomenon enhanced by the "layering" effect of fresh and salt water in these habitats (South & Hill, 1970). Judging from the age of some of the globular tufts at some of these sites, the authors suggest the plants can presumably withstand a number of successive winters of ice encasement without undue harm. Such conditions during the particularly stormy months of the year could possibly ensure the survival of mackaii in these localities. The extreme sheltered conditions occupied by the ecad, and its free-living habit would preclude it, however, from the severest action of pack ice frequently occurring on the open coast in Newfoundland. Although some other species, such as the gammarid amphipod *Hyale prevostii*, will be more intolerant of long and short term changes in temperature the key species, the ecad, is likely to tolerate such changes and so intolerance is assessed as low. Metabolic and reproductive processes which may be affected by a drop in temperature are likely to return to normal very quickly.

Salinity changes - local increase	The development and maintenance of the ecad depends on the frequent alternation of high and low salinity. These conditions occur between high and low water neaps, in places where freshwater streams have an influence but where there is full marine salinity for a period during the tidal cycle. Therefore, it is expected that a long term increase in salinity would be detrimental to the species and hence the biotope and a rank of high is recorded. Information on recovery can be found in 'additional information' below.
Water flow (tidal current) changes - local increase	The biotope occurs in very sheltered locations with weak or very weak tidal streams because the mackaii ecad is unattached. Therefore, the biotope is likely to be highly intolerant of an increase in water flow rate because plants of the characterizing species will be washed away. The attached form and the other fucoid algal species in the biotope are able to tolerate higher water flow rates than the unattached ecad. For recovery see additional information.
Water flow (tidal current) changes - local decrease	The biotope occurs in very sheltered locations where water flow rates may be negligible so a decrease is not relevant.
Emergence regime changes - local increase	*Ascophyllum nodosum* is normally exposed to air for no more than a few hours (Lüning, 1990). An increase in the period of emersion would subject the species to greater desiccation and nutrient stress, leading to a depression in the upper limit of the species distribution on the shore. Other species are also likely to be affected in a similar way so intolerance of the biotope is considered to be intermediate. Where present the ecad can proliferate itself vegetatively from its own broken fragments which continue to divide forming new plants. Therefore, recovery should be possible within five years although it may take longer for plants to return to original density and biomass so a rank of moderate of reported.
Emergence regime changes - local decrease	*Ascophyllum nodosum* ecad mackaii and its component species are all likely to survive increased or full immersion. However, a reduction in the period of emersion may result in the species being competitively displaced by faster growing species and may allow the upper limit of the population of *Ascophyllum nodosum* to extend up the shore.
Wave exposure changes - local increase	The biotope is likely to be highly intolerant of increases in wave exposure because the free living mackaii ecad of *Ascophyllum nodosum* only develops in locations of extreme shelter. Increased wave action could also result in the displacement of plants from ideal conditions. In addition the fauna that shelter in plants are also likely to be displaced if wave action increases. Therefore, the intolerance of the biotope is considered to be high. Recoverability is assessed as low because it is not known if lost beds can recover - see additional information.
Wave exposure changes - local decrease	*Ascophyllum nodosum* ecad mackaii only develops in areas of extreme shelter where wave exposure in negligible so a decrease in wave exposure at the level of the benchmark is not relevant.
Water clarity increase	A decrease in turbidity would increase the light available for photosynthesis during immersion which may increase growth rates of all the algae in the biotope. Upon return to previous turbidity levels the photosynthesis rate would return immediately to normal.

Water clarity decrease	An increase in turbidity would reduce the light available for photosynthesis during immersion. However, the species is found at the upper and mid-tide levels and so is subject to long periods of emersion during which time it can continue to photosynthesize as long as the plant has a sufficiently high water content. Therefore, photosynthesis and consequently growth will be unaffected during this period and so intolerance of the species, and hence the biotope, is considered to be low. Upon return to previous turbidity levels the photosynthesis rate would return immediately to normal.
Habitat structure changes - removal of substratum (extraction)	Although the mackaii ecad of *Ascophyllum nodosum* is unattached the species is likely to be removed along with substratum removal. Other key or characterizing species in the biotope will also be removed and so intolerance is considered to be high. For recoverability see additional information.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	Frond injury in the mackaii ecad is common and often severe and plays an important part in the life of plants (Gibb, 1957). Injury influences the branching of the plant by acting as a stimulus for the development of lateral branches. Therefore, the plants are likely to have low intolerance to abrasion. However, a passing scallop dredge, or similar impact, is likely to physically remove a number of the plants themselves, similar to but not as extensive as substratum loss above. Therefore, an intolerance of intermediate has been recorded. Where present, the ecad can proliferate itself vegetatively from its own broken fragments which continue to divide forming new plants. Therefore, recovery should be possible within five years although it may take longer for plants to return to original density and biomass so a score of moderate of reported.
Siltation rate changes	The key species, *Ascophyllum nodosum* ecad mackaii, is likely to be intolerant of smothering by 5 cm of sediment because photosynthesis would not be possible and plants would also be likely to rot underneath the smothering material. The habitats in which the ecad is found are very sheltered from wave exposure and tidal streams so sediment is unlikely to be removed by water movement. However, some component species such as amphipods and snails may excavate out of the sediment. Thus, because the key characterizing species is lost the biotope will also be lost if smothered and so is considered to be highly intolerant. The small embayments and inlets, often enclosed by rocky headlands, the typical habitat for *Ascophyllum nodosum* ecad mackaii, are vulnerable to infilling for land-based deposits for marine industries such as fish and shellfish farms, slipways, car parks and other developments (Anonymous, 1999(t)). For recoverability see additional information.
	Ascophyllum nodosum ecad mackaii is not likely to be directly intolerant of an increase in suspended sediment because although turbidity will increase, photosynthesis can still occur when the tide is out (see turbidity). However, settlement out of the sediment may cover some surfaces of the plant, reducing photosynthesis rates which may reduce growth. Other species in the biotope, in particular the suspension feeders, such as *Lanice conchilega*, are likely to be more intolerant because an increase in suspended sediment may interfere with feeding, increase cleaning costs and result in lower growth rates. However, the impact on the biotope as a whole will be negligible so intolerance has been assessed as low. On return to pre-impact suspended sediment levels feeding rates of affected species and photosynthetic rates will return to normal very rapidly.

	Ascophyllum nodosum ecad mackaii is not likely to be directly intolerant of a decrease in suspended sediment because the species is a primary producer. Other species in the biotope, in particular the suspension feeders, such as *Lanice conchilega*, are likely to be more intolerant because a decrease in suspended sediment may also result in a decrease in food supplies so growth may be affected. However, the impact on the biotope as a whole will be negligible so intolerance has been assessed as low. On return to pre-impact suspended sediment levels feeding of affected species and photosynthetic rates will return to normal very rapidly.
Visual disturbance	Macrophytes have no known visual sensors. Most macroinvertebrates have poor or short range perception and are unlikely to be affected by visual disturbance such as boat traffic or walkers on the shore.
Introduction or spread of non-indigenous species.	Although bacteria and fungi are associated with the attached form of *Ascophyllum nodosum* no information could be found on any disease causing microbes in the biotope and so intolerance is assessed as low. However, there is always the potential for this to change.
Introduction of microbial pathogens	There is insufficient information on the response of the key and other organisms in the biotope to changes in oxygenation to make an assessment. However, an oxygen concentration of 2 mg/l is thought likely to cause effects in marine organisms (Cole et al., 1999) and if experienced for a period of one week is likely to result in the death of some intolerant species.
Removal of target habitat	There are no records of any non-native species invading the biotope that may compete with or graze upon *Ascophyllum nodosum* ecad mackaii and so the biotope is assessed as not sensitive. However, as several species have become established in British waters there is always the potential for an adverse effect to occur.
Removal of non-target habitat	The attached form of *Ascophyllum nodosum* is still collected on a small scale in western Scotland for the extraction of alginate. The unattached mackaii ecad is very easy to collect as it does not need cutting from the rock and it has been collected along with the attached form in the past. For example, *Ascophyllum nodosum* ecad mackaii beds and associated communities in the Uists in the Outer Hebrides have been decimated by removal of plants. *Littorina littorea* is also harvested by hand, without regulation, for human consumption. In some areas, notably Ireland, collectors have noted a reduction in the number of large snails available. It is likely that at least part of the population of either of these two species may be lost and accordingly, intolerance has been assessed as intermediate. It is not known if it is possible, or how long it takes, for beds of *Ascophyllum nodosum* ecad mackaii to recover from harvesting. For example, there was no sign of recovery of a bed two years after its removal at Kyle of Loch alsh (Anonymous, 1999(t)). However, once present the ecad can proliferate itself vegetatively from its own broken fragments which continue to divide forming new plants. Therefore, recovery should be possible within five years although it may take longer for plants to return to original density and biomass so a rank of moderate of reported.

2.6	Estuarine Rocky Habitats SLR.Asc
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	*Ascophyllum nodosum* occurs in waters warmer than those around Britain and Ireland (e.g. Portugal) and similar assemblages of species are known to occur in Brittany so that long-term temperature change is unlikely to have a significant impact on the biotope. Schonbeck & Norton (1979) demonstrated that fucoids can increase tolerance in response to gradual change in a process known as 'drought hardening'. Hawkins & Hartnoll (1985) report that fucoids are more intolerant of sudden changes in temperature and relative humidity observing the bleaching and death of plants during periods of hot weather (Hawkins & Hartnoll, 1985). However, intertidal algae, such as *Ascophyllum nodosum*, are regularly exposed to rapid and short-term variations in temperature. Both exposure at low tide or rising tide on a sun-heated shore may involve considerable temperature changes, and during winter the air temperature may be far below freezing point. Growth of *Ascophyllum nodosum* has been measured between 2.5 and 35°C with an optimum between 10 and 17°C (Strömgren, 1977). All other key species are moderately tolerant of temperature changes at the benchmark level. Larvae and juvenile individuals are likely to be more intolerant of changes in temperature than adults. The balance of interactions between fucoids and limpets plus barnacles change with geographical location. Warmer conditions (e.g. Spain and Portugal) favour greater penetration of limpets and barnacles into sheltered locations (Ballantine, 1961 cited in Raffaelli & Hawkins, 1996). Warmer conditions are also likely to favour *Chthamalus* spp. rather than *Semibalanus balanoides* although a change of species will not alter the function of the biotope. However *Ascophyllum nodosum* has been found to be damaged by thermal pollution if the water temperature is above 24°C for several weeks (Lobban & Harrison, 1997) and the southern limit of the species distribution is controlled by the maximum summer temperature of about 22°C (Baardseth, 1970). Provided the temperature has not exceeded the critical limits it will soon recover on return to normal conditions.
Temperature changes - local decrease	*Ascophyllum nodosum* occurs in waters cooler than those around Britain and Ireland and similar assemblages of species are known to occur in Norway so that long-term temperature decrease is unlikely to have a significant impact on the biotope. *Ascophyllum nodosum* can tolerate freezing as it has been observed to survive in a block of ice for several days. However, temperature is important for reproduction in *Ascophyllum nodosum*. David (1943) suggests that temperature could provide the stimulus for gamete release. Studies in Maine, USA (Bacon & Vadas, 1991) and in Norway (Printz, 1959) have shown that gamete release in both countries commences at 6°C and in Maine terminated at about 15°C. Colder conditions (e.g. Norway) favour expansion of fucoids into exposed conditions at the expense of limpets and barnacles (Ballantine, 1961 cited in Raffaelli & Hawkins, 1996). Cooler temperatures also favour *Semibalanus balanoides* rather than the chthamalid barnacles although a change of species is not likely to change the overall nature of the biotope. Provided the temperature has not exceeded the critical limits it will soon recover on return to normal conditions.
Salinity changes - local	The biotope occurs in full, reduced or variable salinity but there are no reports of the biotope occurring in hypersaline areas. *Ascophyllum nodosum* is euryhaline species with a salinity tolerance of about 15 to 37 psu

increase	(Baardseth, 1970). Therefore, it seems likely that the biotope will be highly intolerant of increases in salinity.
Water flow (tidal current) changes - local increase	Significant increases in water flow rate may cause some of the macro algal populations to be torn off the substratum. However, the biotope is found in strong tidal streams, such as experienced in the narrows of sea lochs and so it seems likely that the biotope will have low intolerance to an increase in water movement. *Patella vulgata* and attached species such as the barnacles will remain attached to the rock even in strong water flow although feeding may be impaired. On the lower shore the increased water movement encourages several filter feeding faunal groups, such as sponges and ascidians, to occur and so species richness would probably increase and could lead to the development of the sub-biotope SLR.Asc.T.
Water flow (tidal current) changes - local decrease	The effect of a decrease in water flow rate is likely to be low because the biotope is also found on shores with low water flow. However, a certain degree of water flow is required to supply nutrients and remove waste products so a reduction in the water flow below a certain level may have an adverse effect on the species and hence the biotope. Barnacle growth rates are lower in reduced water flow and this may promote additional fucoid coverage.
Emergence regime changes - local increase	*Ascophyllum nodosum* is normally exposed to air for no more than a few hours in each tidal cycle (Lüning, 1990). An increase in the period of emersion of 1 hour would subject the species to greater desiccation and nutrient stress and may lead to the death of some organisms at the uppermost limit of species distribution on the shore. Thus, the biotope is likely to be lost at the upper limit of its range but may be able to extend further down the shore so that the overall impact is a shifting of the biotope downwards. However, an extension of the biotope is likely to be very slow because *Ascophyllum nodosum* has very poor recruitment, settling infrequently so that recolonization can take many years (see additional information). Thus, because a proportion of the biotope is likely to be lost a rank of intermediate is reported. Loss of the seaweed will have consequential effects such as the loss of other species using the weed as substratum, including *Littorina littorea* or as food and shelter, such as *Hyale prevosti*. Areas previously covered by algae may become dominated by more emergence tolerant species such as barnacles.
Emergence regime changes - local decrease	A reduction in the period of emersion may result in *Ascophyllum nodosum* being competitively displaced by faster growing species at the bottom of its range and may allow the upper limit of the population and hence the biotope to extend up the shore. However, *Ascophyllum nodosum* settles infrequently and recruitment to colonize new areas and thus compensate for loss of plants would be very slow (see additional information).
Wave exposure changes - local increase	*Ascophyllum nodosum* cannot resist very heavy wave action so exposure to wave action is an important factor controlling the distribution of the species, and therefore the biotope. Work in New England has suggested that the distribution of *Ascophyllum nodosum* may be directly set by wave action preventing settlement of propagules (Vadas et al., 1990). In moving from protected sites to the open sea the number of plants become progressively reduced, and individual plants become increasingly short and stumpy (Baardseth, 1970) and with a higher percentage of injured tissue (Levin & Mathieson, 1991). Thus, the species is only present in sheltered or moderately exposed locations and increased wave exposure causes plants to be torn off the substratum and replaced by *Fucus vesiculosus*. The dense Ascophyllum beds of the SLR.Asc biotopes can only develop in sheltered to extremely sheltered conditions. Thus, an increase in wave exposure of two

	ranks on the exposure scale, e.g. from sheltered to exposed, is likely to result in the removal of many plants from the substratum and the loss of the biotope and so intolerance is considered to be high. On return to normal conditions recovery is likely to be low because of poor recruitment and slow growth - see additional information for full rationale.
Water clarity increase	A decrease in turbidity would increase the light available for photosynthesis during immersion which may increase growth rates of all the algae in the biotope. Upon return to previous turbidity levels the photosynthesis rate would return immediately to normal.
Water clarity decrease	An increase in turbidity would reduce the light available for photosynthesis during immersion which could result in reduced biomass of plants. However, the biotope is found at the upper and mid-tide levels and so is subject to long periods of emersion during which time macroalgae can continue to photosynthesize as long as plants have a sufficiently high water content. Therefore, photosynthesis and consequently growth will be unaffected during this period and so intolerance of the macroalgal species, and hence the biotope, is considered to be low. Upon return to previous turbidity levels the photosynthesis rate would return immediately to normal.
Habitat structure changes - removal of substratum (extraction)	All key and important species in the biotope are highly intolerant of substratum loss. The algae and barnacles are permanently attached to the substratum so populations would be lost. Epifaunal grazers like *Patella vulgata* and littorinid snails are epifaunal and likely to be removed along with the substratum. Those that do remain will be subject to increased risk of desiccation and predation and so populations are unlikely to survive. Mobile species like the amphipod *Hyale prevostii* will be indirectly affected by the loss of fucoid plants as will sessile epiphytic flora and fauna. Recovery is low. See additional information for rationale.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	Trampling on the rocky shore has been observed to reduce fucoid cover which decreased the microhabitat available for epiphytic species, increased bare space and increased cover of opportunistic species such as Ulva (Fletcher & Frid, 1996). *Ascophyllum nodosum* seems to be particularly intolerant of damage from trampling (Flavell, 1995 cited in Holt et al., 1997). It is also likely to be removed if shores are mechanically cleaned following oil spills. Light trampling pressure has also been shown to damage and remove barnacles (Brosnan & Crumrine, 1994). Thus, trampling can significantly affect community structure and intolerance has, therefore, been assessed as high. *Ascophyllum nodosum*, has poor recruitment rates and is slow growing, limiting recovery (Holt et al., 1997). The lack of recovery of *Ascophyllum nodosum* from harvesting is well documented. For example, in their work on fucoid recolonization of cleared areas at Port Erin, Knight and Parke (1950) observed that even eight years after the original clearance there was still no sign of the establishment of an *Ascophyllum nodosum* population. Therefore, recovery is likely to be low.
Siltation rate changes	A 5 cm layer of sediment or debris on a dense fucoid shore will reduce photosynthesis in algae that are covered and may cause some plants to rot. However, the dominant species, *Ascophyllum nodosum*, and its associated species would float above the layer of silt and almost certainly survive. Sediment will have an especially adverse effect on young germling algae and on the settlement of larvae and spat. Barnacle feeding may be affected and limpet locomotion and grazing may be impaired. Lower down the shore active suspension feeders such as sponges and mussels may be killed by smothering. However, as not all species are lost, and *Ascophyllum nodosum* in particular survives, intolerance is intermediate and as the slow recruiting keystone species survives recovery will be high. On sheltered shores there

	is not likely to be enough wave action to mobilise sediment to alleviate the effects of smothering. For recovery see additional information.
	Ascophyllum nodosum, and the other macroalgal species in the biotope, are probably relatively tolerant of an increase in suspended sediment because they are primary producing species. Settlement out of the sediment may cover some surfaces of the plants, reducing photosynthesis rates which may reduce growth and in the sheltered conditions in which the biotope is found will probably not be removed by wave action. However, the direct effects of increased suspended sediment (see turbidity for indirect effects of light attenuation) on photosynthesising plants are not expected to be significant. *Patella vulgata* invade the lower reaches of estuaries where there is sufficient rock or stone on which it may live, and in such muddy habitats, with abundant silt and detritus, the growth rate is rapid (Fretter & Graham, 1994) although the species is absent from some sheltered shores where silt and algal turfs are likely to restrict space (Professor S.J. Hawkins, pers. comm.). Other species in the biotope, such as suspension feeding barnacles, sponges and tunicates (sea squirts), are likely to be more intolerant because an increase in suspended sediment may interfere with feeding, increase cleaning costs and result in lower growth rates. However, the impact of an increase in suspended sediment of 100mg/l for a month on the biotope as a whole will be sublethal effects such as reduced growth etc. so intolerance has been assessed as low. There may be a loss of a few very intolerant species. On return to pre-impact suspended sediment levels feeding rates of affected species and photosynthetic rates will return to normal very rapidly.
	Ascophyllum nodosum is not likely to be directly intolerant of a decrease in suspended sediment because the species is a primary producer. Other species in the biotope, in particular the suspension feeding barnacles, sponges and tunicates, are likely to be more intolerant because a decrease in suspended sediment may also result in a decrease in food supplies so growth may be affected. However, the impact of a decrease, of 100 mg/l suspended sediment for a month, on the biotope as a whole will be sublethal effects (i.e. growth, fecundity etc.) so intolerance has been assessed as low. On return to pre-impact suspended sediment levels feeding of affected species and photosynthetic rates will return to normal very rapidly.
Introduction or spread of non-indigenous species.	Although bacteria and fungi are associated with *Ascophyllum nodosum* no information could be found on any disease causing microbes in the biotope and so intolerance is assessed as low. However, there is always the potential for this to change.
Removal of target habitat	There are no records of any non-native species invading the biotope that may compete with or graze upon *Ascophyllum nodosum* and so the biotope is assessed as not sensitive. However, as several species have become established in British waters there is always the potential for this to occur. The Australasian barnacle *Elminius modestus* does well in estuaries and bays where it can displace the native *Semibalanus balanoides*. Its overall effect on the dynamics of rocky shores has however, been small as *Elminius modestus* has simply replaced some individuals of a group of co-occurring barnacles (Raffaelli & Hawkins, 1996).

Removal of non-target habitat	Harvesting of *Ascophyllum nodosum* for alginate is commonly carried out in most areas of its distribution. In an area of Strangford Lough, where harvesting on a small scale was carried out and then stopped, ecological effects were noticed several years later (Boaden & Dring, 1980). The growth rate of *Ascophyllum nodosum* had increased but shore cover was less. Cover by green algae and *Fucus vesiculosus* had increased. Patella density had increased and mean size decreased. Microalgal cover of boulders had increased. Sediment median diameter had increased. *Halichondria panicea*, Hymeniacidon and to a lesser extent *Balanus crenatus* had decreased. Underboulder fauna remained impoverished by a factor of between one- and two-thirds. Removal of limpets, which graze upon fucoid sporelings, is likely to benefit fucoid plants. Removal of other important species in the biotope, such as *Hyale prevostii* and *Semibalanus balanoides* may reduce grazing pressure on fucoid plants which may ameliorate the effects of removal of *Ascophyllum nodosum* to a certain extent. *Littorina littorea* is often a dominant grazing gastropod on the lower shore. The species has some commercial value and is gathered by hand at a number of localities, particularly in Scotland and in Ireland. Demand increases considerably over Christmas from the French market. Overall, intolerance has been assessed as intermediate to reflect the likelihood that the extent of the biotope will decrease. Recovery is likely to be moderate (see additional information).

2.6	**Estuarine Rocky Habitats MLR.BF**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The biotope occurs in warmer and colder parts of Britain and Ireland and similar assemblages of species are known to occur in Norway, Canada and Brittany so that long-term temperature change is unlikely to cause a change in biotope. Schonbeck & Norton (1979) demonstrated that fucoids can increase tolerance in response to gradual change in a process known as 'drought hardening'. However, fucoids are more intolerant of sudden changes in temperature and relative humidity with field observations of bleaching and death of plants during periods of hot weather (Hawkins & Hartnoll, 1985). All other key species are moderately tolerant of temperature changes at the benchmark level and so intolerance of the biotope is assessed as intermediate. Larvae and juvenile individuals are likely to be more intolerant of changes in temperature than adults. Changes in the numbers of the key structuring species are likely to have profound effects on community structure.
Salinity changes - local increase	Barnacle and fucoid shores are able to tolerate short term variations in salinity because the littoral zone is regularly exposed to precipitation. All key species are able to penetrate into lower salinity estuarine waters, down to about 20psu so the biotope can tolerate long term reductions in salinity within its normal tolerance range although growth rates and fecundity are likely to be impaired. However, some of the other species within the biotope may be highly intolerant of changes in salinity resulting in a loss of diversity. However most species have planktonic larvae so recolonization and recovery should be high.

Water flow (tidal current) changes - local increase	Significant increases in water flow rate may cause some of the macro algal populations to be torn off the substratum. On the lower shore however, increased water movement encourages several filter feeding faunal groups, such as sponges and ascidians, to occur and species richness may increase. The effect of a decrease in water flow rate is likely to be low because the biotope is also found on shores with low water flow. However, barnacle growth rates are lower in reduced water flow and this may affect the balance of the barnacle-fucoid mosaic, perhaps promoting fucoid dominated shores such that MLR.BF becomes replaced by another biotope such as SLR.Fserr.
Emergence regime changes - local increase	A change in the level of emergence on the shore will affect the upper or lower distribution limit of all the key species. Changes in the numbers of important species are likely to have profound effects on community structure and may result in loss of the biotope at the extremes of its range. For example, at the upper limit the biotope may lose fucoid cover and so change to one dominated by barnacles and limpets such as ELR.MB.Bpat.
Wave exposure changes - local increase	The effect of changes in wave action on barnacle and fucoid community stability is predominantly through its influence on the balance of the biological interactions. In increasing wave action, fucoids may be removed and grazers and barnacles are favoured at the expense of the fucoids, and a stable situation with minimal fucoid cover prevails. *Ascophyllum nodosum*, in particular is very intolerant of increased wave exposure. Conversely, if wave exposure reduces fucoids are favoured and maintain a more or less total and permanent canopy (Hartnoll & Hawkins, 1985). Thus, if wave exposure changes the biotope can rapidly disappear to be replaced by another, barnacle dominated on extremely exposed shores (ELR.Bpat) and dense fucoid cover on sheltered shores (SLR.F.Fser). The loss of fucoid plants results in the loss of structural complexity and invertebrate species diversity may decline in the absence of microhabitats and refugia.
Water clarity decrease	Intolerance to turbidity is low because the key species are relatively tolerant of changes in turbidity and the biotope is also found in areas of low water flow where turbidity is likely to be high. An increase in turbidity may reduce algal growth rates because of increased light attenuation although because photosynthesis also occurs during emersion the effect may not be significant. There may be some clogging of suspension feeding apparatus in some species although characteristic species survive in occasionally very turbid conditions and increased turbidity often means an increase in available food particles.
Habitat structure changes - removal of substratum (extraction)	All key and important species in the biotope are highly intolerant of substratum loss. The algae and barnacles are permanently attached to the substratum so populations would be lost. Epifaunal grazers like *Patella vulgata* and littorinid snails are epifaunal and substratum loss causes increased risk of desiccation and predation and so populations are unlikely to survive. Mobile species like the amphipod *Hyale prevostii* will be indirectly affected by the loss of fucoid plants as will sessile epiphytic flora and fauna. Recovery is good because recruitment of key species, with the exception of *Ascophyllum nodosum*, is fairly rapid so that the biotope will look much as before within five years. However, it can take between 10 and 15 years for the natural variation in community structure of the biotope to return to normal after significant mortality of key species such as seen after the Torrey Canyon oil spill (Southward & Southward, 1978).

Heavy abrasion, primarily at the seabed surface	The rocky intertidal is not at risk from boating activity but is susceptible to abrasion and physical impact from trampling. Even very light trampling on shores in the north east of England was sufficient to reduce the abundance of fucoids (Fletcher & Frid, 1996) which, in turn reduced the microhabitat available for epiphytic species. Trampling damage is particularly serious for the long-lived but slowly recruiting *Ascophyllum nodosum*. Light trampling pressure, of 250 steps in a 20x20 cm plot, one day a month for a period of a year, has also been shown to damage and remove barnacles (Brosnan & Crumrine, 1994). Trampling pressure can thus result in an increase in the area of bare rock on the shore (Hill et al., 1998). Chronic trampling can affect community structure with shores becoming dominated by algal turf or crusts. However, if trampling stops, recovery should be good. In Oregon for example, the algal-barnacle community recovered within a year after trampling stopped (Brosnan & Crumrine, 1994).
Light abrasion at the surface only	
Siltation rate changes	A 5cm layer of sediment or debris on a barnacle and fucoid shore is likely to reduce photosynthesis of algae and may cause some plants to rot. Sediment will have an especially adverse effect on young germling algae and on the settlement of larvae and spat. Barnacle feeding may be affected and limpet locomotion and grazing may be impaired. Lower down the shore active suspension feeders such as sponges and mussels may be killed by smothering. However, since wave action on rocky shores is likely to mobilise sediment alleviating the effect of smothering intolerance has been assessed as intermediate. Most characterizing species have planktonic larvae and/or are mobile and so can migrate into the affected area so recovery should be high.
	The biotope is likely to have some tolerance of suspended sediment and siltation as it is also found on sheltered shores where siltation may occur and key species in the biotope have low intolerance to the factor. However, suspended sediment may clog respiratory and feeding organs of other species such as sea squirts and spirorbid worms and so epifaunal species composition may change if suspended sediment changes significantly.
Underwater noise changes	None of the selected key or important species in the biotope are recorded as sensitive to noise although limpets and amphipods do respond to vibration. However, the biotope as a whole is not likely to be sensitive to changes in noise levels.
Introduction or spread of non-indigenous species.	The cryptoniscid isopod *Hemioniscus balani* is a widespread parasite of barnacles, found around the British Isles. Heavy infestation inhibits or destroys the gonads resulting in castration of the barnacle. High levels of infestation may reduce barnacle abundance and distribution which would impact on patch dominance although no reported cases of this were found.
Introduction of microbial pathogens	Cole et al. (1999) suggest possible adverse effects on marine species below 4 mg/l and probable adverse effects below 2 mg/l. There is no information about key algae species tolerance to changes in oxygenation although Kinne (1972) reports that reduced oxygen concentrations inhibit both algal photosynthesis and respiration. Sensitive species, such as the amphipod *Hyale prevostii*, may be lost resulting in a reduction in diversity.
Removal of target habitat	The Australasian barnacle *Elminius modestus* does well in estuaries and bays where it can displace the native *Semibalanus balanoides*. Its overall effect on the dynamics of rocky shores has however, been small as *Elminius modestus* has simply replaced some individuals of a group of co-occurring barnacles (Raffaelli & Hawkins, 1999).

Removal of non-target habitat	Both *Fucus serratus* and *Ascophyllum nodosum* are harvested within the UK and the extraction of either of these species will have a significant impact on community structure of the biotope. Removal of algal species will result in loss of micro-habitats for other species and, hence, a reduced faunal diversity. However, the loss will favour the barnacles which would be expected to increase in abundance. It is extremely unlikely that any of the other species indicative of sensitivity would be targeted for extraction and overall, an intermediate intolerance has been suggested. Recovery should be high because the key species have a dispersive larval stage and reproduce every year. However, a return to normal community structure dynamics after removal of all key species appears to take much longer, 10 and possibly up to 15 years (Southward & Southward, 1978).

2.6	**Estuarine Rocky Shore SLR.Fcer**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Algal symptoms of thermal stress include frond hardening, bleaching or darkening, and cell plasmolysis. *Fucus spiralis* can tolerate temperatures up to 28°C and a chronic long-term increase in temperature may be beneficial because the optimum temperature for growth of the species is 15°C (Lüning, 1990). However the species showed some damage during the unusually hot summer of 1983 when temperatures were on average 8.3°C higher than normal (Hawkins & Hartnoll, 1985). *Littorina littorea* survives in upper shore rockpools where temperature may exceed 30°C. However, at water temperatures above about 20°C growth rate is reduced. Reproduction in *Semibalanus balanoides* is inhibited by temperatures greater than 10°C (Barnes, 1989). Cirral beating rate reaches a maximum at 18°C in the British Isles (Southward, 1955). This rate declines until all spontaneous activity ceases at 31°C and at a temperature of 37°C a coma is induced (Southward, 1955). Intolerance has been assessed to be low as species within the biotope seem relatively tolerant of temperature increases above that of the benchmark.
Temperature changes - local decrease	The distribution of fucoid species within the biotope extends to the north of the British Isles, so would probably be tolerant of a long-term chronic decreases in temperature. Of the other species in the biotope, adult *Littorina littorea* can tolerate sub-zero temperatures and the freezing of over 50 ° of their extracellular body fluids. In colder conditions an active migration may occur down the shore to a zone where exposure time to the air (and hence time in freezing temperatures) is less. The snails are able to tolerate these low temperatures by drastically reducing their metabolic rate (down to 20 ° of normal). However, long-term chronic temperature decreases may slow down growth. *Semibalanus balanoides* acquires an exceptional tolerance to cold in December and January which is lost between February and April. The median lethal temperature in January was -17.6°C in air for 18 hours, whereas animals in June could only withstand -6.0°C (Crisp & Ritz, 1967). *Semibalanus balanoides* was not affected during the severe winter of 1962-63 in most areas, except the south east coast which suffered 20-100 ° mortality. (Crisp, 1964). However, recovery was rapid in this instance due to heavy settlement the following June (Crisp, 1964). The mean monthly sea temperature must fall below 7.2°C for the gametes to mature (Barnes, 1958).

	Intolerance has been assessed to be low as temperature decreases may affect species viability rather cause mortalities at the benchmark level. On return to prior conditions recovery is likely to be immediate.
Salinity changes - local increase	*Fucus ceranoides* is physiologically adapted to brackish conditions. It is thought to be absent from fully saline sites due to an inability to compete with the faster growing fucoids, such as *Fucus vesiculosus* and a physiological intolerance of fully saline conditions. When cultured in high salinity, Suryono & Hardy (1997) found that plant tissue decayed within 5 to 6 weeks. Khjafi & Norton (1979) recorded similar results, but, Baeck et al. (1992) found that *Fucus ceranoides* grew at full salinity for 11 weeks. The biotope is likely to have a high intolerance to a chronic long-term increase in salinity as the key characterizing species *Fucus ceranoides* would be replaced by fucoid species that thrive in marine conditions. In the absence of *Fucus ceranoides* the biotope would not be recognized. Species richness may rise as the substratum would probably to colonized by marine species which were previously excluded by an intolerance to reduced salinity. On return to prior conditions, reduced salinity would exert a physiological stress upon colonizing species, probably reducing their abundance and allowing *Fucus ceranoides* to become established and dominate again. Therefore recoverability has been assessed to be high.
Water flow (tidal current) changes - local increase	Tidal flow in the biotope is typically very low in the biotope, therefore it is reasonable to expect that the biotope would be intolerant of an increase in water flow rate from negligible to moderately strong (0.5 -1.5 m/sec). Fronds of the seaweed would generally conform to the flow, but may be torn or damaged. *Littorina littorea* is found in areas with water flow rates from negligible to strong. Increases in water flow rates above 6 knots may cause *Littorina littorea* in less protected locations (e.g. not in crevices etc) to be continually displaced into unsuitable habitat but in this biotope such displacement is unlikely to occur. Barnacles can tolerate very high flow rates so would not be affected. Intolerance has been assessed to be intermediate as dominant species within the biotope may be damaged. Recoverability has been assessed to be high (see additional information below).
Water flow (tidal current) changes - local decrease	A water flow is important in gas exchange for photosynthesis, respiration and consequently growth of seaweed. Water flow rate in the biotope is typically weak/negligible so an additional decrease in water flow may cause stagnation of the surrounding water, with consequential effects on growth. However, nutrients would be replenished by the flood tide, so on balance effects are unlikely to be significant and an assessment of not sensitive has been made.
Emergence regime changes - local increase	Illuminated intertidal *Fucus* plants grow significantly only when submerged; irradiating them while emersed (but unstressed) is ineffective (Schonbeck & Norton, 1979). Removal from water also deprives seaweeds from their source of nutrients, including most of the inorganic carbon. As soon as seaweed is removed from water its photosynthesis rate drops sharply. *Semibalanus balanoides* and *Littorina littorea* would experience reduced feeding opportunities, as the balances would remain closed and the snails would need to seek refuge in damp areas to avoid desiccation or migrate to other habitats where feeding activity is not hindered. Intolerance has been assessed to be low owing to effects on species viability (e.g. reduced growth). Recoverability on return to prior conditions has been assessed to be immediate.

Emergence regime changes - local decrease	A decrease in the emergence regime would reduce desiccation stress and periods of nutrient deprivation endured by the seaweeds. The upper limit of the biotope may also increase up the shore. However, increased immersion would favour the grazing activity of *Littorina littorea* whose mobility is hindered by dry conditions (it has to produce extra mucus to move) and hence the grazing pressure exerted by it on the algal species may increase. However, intolerance has been assessed to be low.
Wave exposure changes - local increase	Wave action is a major cause of seaweed mortality at all stages of growth, especially for settling spores. Increases in wave exposure would probably result in plants and germlings of *Fucus ceranoides* being torn off the substratum or mobilisation of the substratum with the plants attached, especially so in the SLR.FcerX biotope where the substratum may consist largely of mobile cobbles and rocks. The biotope contains other fucoids, despite reduced salinity, although *Fucus ceranoides* always dominates. For instance, *Ascophyllum nodosum* cannot resist very heavy wave action and wave action is an important factor controlling the distribution of this species. In moving from protected sites to the open sea the number of plants become progressively reduced, and individual plants become increasingly short and stumpy (Baardseth, 1970) and with a higher percentage of injured tissue (Levin & Mathieson, 1991). On wave exposed shores prosobranchs may be dislodged or damaged. *Littorina littorea* regularly have to abandon optimal feeding sites in order to avoid wave-induced dislodgement which may result in a decreased growth rate (Mouritsen et al., 1999). Increases in wave exposure will probably cause a decrease in population size. Intolerance to increased wave action has been assessed to be intermediate, as some individuals may be lost or damaged. Recoverability of fucoid species, with the exception of *Ascophyllum nodosum*, and faunal species is likely to be high (see additional information below).
Wave exposure changes - local decrease	The biotope typically occurs in locations that are very/extremely sheltered from wave action, therefore an intolerance assessment of a further decrease in this factor was not considered relevant.
Water clarity increase	Decreased turbidity and the concomitant increase in light penetration of the water column would favour photosynthesis by the dominant fucoid species and Enteromorpha with enhanced growth. The biotope has therefore been assessed not to be sensitive*.
Water clarity decrease	Changes in turbidity would alter the light available for photosynthesis during immersion. In laboratory experiments, Strömgren & Nielsen (1986) observed that there was a strong correlation between the total radiant energy during the day and the average daily growth rates whilst Ramus et al. (1977) observed reduced growth rates of fucoid algae with depth. Thus, increased turbidity has the potential to cause local reduction in fucoid biomass. Intolerance has been assessed to be low owing to effects on the viability of seaweed species that this factor would have. On return to prior conditions recovery is likely to be rapid as increased light penetration would favour photosynthesis and hence growth.
Habitat structure changes - removal of substratum (extraction)	Seaweed species that characterize this biotope are permanently attached to the substratum, species such as barnacles and *Littorina littorea* are epilithic, all would be removed with the substratum. Intolerance has therefore been assessed to be high. Recoverability has been assessed to be high (see additional information below).

Heavy abrasion, primarily at the seabed surface	Abrasive forces can damage and remove fronds and germlings of *Fucus ceranoides* and other algae. Abrasion caused by human trampling can significantly reduce the cover of fucoid algae on a shore (Holt et al., 1997) and may be the most relevant source of abrasion and physical disturbance to the SLR.Fcer biotope. Therefore, intolerance has been assessed to be intermediate. Recoverability of fucoid species (except *Ascophyllum nodosum*) and faunal species is likely to be high (see additional information below).
Light abrasion at the surface only	
	The effects of smothering would depend on the state of the tide when the factor occurred. If smothering happened when the tide was out, the seaweed would be buried under the sediment reducing CO_2 diffusion, light penetration and hence photosynthesis. If smothering occurred while the tide was in, some fronds of the seaweed might escape burial allowing the plant continue photosynthesis. Prosobranchs may experience difficulties in regaining the surface, in the case of *Littorina littorea* death normally occurs within 24 hours. However, if the sediment is well oxygenated and fluid (as with high water, high silt content) snails may be able to move back up through the sediment. Smothering would bury barnacles and prevent feeding. It is likely that barnacles could withstand smothering for some period of time because they are able to respire anaerobically, however no studies have been found to confirm survival under sediment. Intolerance has been assessed to be intermediate as some individuals might die and in general the viability of populations would be reduced. Recovery has been assessed to be high (see additional information below).
Siltation rate changes	The seaweed species of the biotope would not be directly affected by an increase in suspended sediment (effects of light attenuation are addressed under turbidity). Barnacles may experience some clogging of its feeding apparatus, to be cleared at energetic cost, whilst increases in siltation resulting from increased suspended sediment over the period of a year, may in part, have some influence in changing substratum type and clog crevices utilized by prosobranchs, such as *Littorina littorea*, to avoid desiccation. If habitat type is no longer optimal then the snail population may decrease. Intolerance has been assessed to be low as the viability of some species may be reduced, e.g. prosobranch species. Recoverability has been assessed to be high on return to prior conditions (see additional information below).
	The biotope is likely to be not sensitive to a decrease in suspended sediment because most of the key characterizing species are primary producers and do not require particles for feeding or tube building. Barnacles may be more intolerant because a decrease in suspended sediment may result in a decrease in food availability, so growth may be affected. Intolerance has been assessed to be low as viability of the species may be reduced for the period that the factor operates. On return to prior conditions optimal feeding would probably commence almost immediately.
Introduction or spread of non-indigenous species.	Barnacles are parasitised by a variety of organisms and, in particular, the cryptoniscid isopod *Hemioniscus balani*. Heavy infestation can cause castration of the barnacle. Levels of infestation within a population vary. Intolerance has been assessed to be low as viability would be affected. Once infected recovery of an individual barnacle is unlikely, species diversity within the biotope may begin to decline owing to reduced recruitment.

Removal of target habitat	The Australasian barnacle *Elminius modestus* was introduced to British waters on ships during the second world war. As the species withstands reduced salinity and turbid waters it consequently does well in estuaries and bays, where it can displace *Semibalanus balanoides* and *Chthamalus* montagui. Balanus improvisus also seems to be retreating where it is in competition with *Elminius modestus* (Crisp, 1958; Hayward & Ryland, 1990; A. Southward pers. comm. to Eno, 1997) *Elminius modestus* may therefore be common in this biotope. Whilst the presence of *Elminius modestus* may affect the viability of a native species, it will not change the structure of the biotope as the two species occupy the same ecological niche. In this instance, the biotope has been assessed to be not sensitive.
Removal of non-target habitat	*Fucus ceranoides* and other important species are not targeted for extraction. *Littorina littorea* is harvested by hand, without regulation, for human consumption. In some areas, notably Ireland, collectors have noted a reduction in the number of large snails available. *Littorina littorea* preferentially grazes on Ulva over tougher fucoid species, a reduction in grazing pressure might allow Ulva to dominate and smother the fucoid species during early stages of recruitment. The biotope may begin to change into another biotope, therefore intolerance has been assessed to be high. Adults are slow crawlers so active immigration of snails is unlikely. The larvae form the main mode of dispersal. *Littorina littorea* is an iteroparous breeder with high fecundity that lives for several (at least 4) years. Breeding can occur throughout the year. The planktonic larval stage is long (up to 6 weeks) although larvae do tend to remain in waters close to the shore. Recruitment and recovery rates should therefore be high.

2.7	Flame & File Shells IMX.Lim
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	*Limaria hians* has been recorded from the Lofoten Isles, Norway south to the Canary Isles and the Azores. Therefore, it is unlikely to be affected by long term changes in temperature at the benchmark level in British waters. Other members of the community may be adversely affected, for example boreal species (e.g. *Balanus crenatus* and *Modiolus modiolus*) may be replaced in the community by more southern species. In addition, reproduction and recruitment in echinoderms, and reproduction in hydroids and bryozoans are probably influenced by temperature (refer to species reviews). Overall, the species composition may vary but the gaping file shell carpet and hence the biotope will probably survive. The biotope is protected from extremes of temperature change by its subtidal habit. Therefore, an intolerance of low has been recorded to represent changes in species composition.
Temperature changes - local decrease	*Limaria hians* has been recorded from the Lofoten Isles, Norway south to the Canary Isles and the Azores. Therefore, it is unlikely to be affected by long term changes in temperature at the benchmark level in British waters. Other members of the community may be affected, for example boreal species (e.g. *Balanus crenatus* and *Modiolus modiolus*) may increase in abundance. In addition, reproduction and recruitment in echinoderms, and reproduction in hydroids and bryozoans are probably influenced by temperature (refer to species reviews). Overall, the species composition may vary but the gaping file shell carpet and hence the biotope will probably survive. The biotope is protected from extremes of temperature change by its subtidal habit. Therefore, an intolerance of low has been recorded to represent changes in species composition.
Salinity changes - local increase	This biotope occurs in full salinity and is unlikely to encounter increases in salinity.
Water flow (tidal current) changes - local increase	This biotope occurs in weak to moderately strong tidal streams. An increase in water flow rate to strong or very strong is likely to physically damage the bed due to drag and modify the substratum in favour of coarser sediments, boulders and bedrock. The additional drag caused by emergent epifauna attached to the carpet, especially if kelps are present, is likely to cause the carpet to be removed in lumps. Holes in the carpet, may then allow mobilization of the sediment, resulting in further damage (see Minchin, 1995). Loss of the carpet will entail loss of the byssal carpet and its associated community, although individual gaping file shells will probably survive and be transported elsewhere (see displacement). Therefore, an intolerance of high has been recorded. Recoverability is likely to be low (see additional information below).
Water flow (tidal current) changes - local decrease	This biotope occurs in weak to moderately strong tidal streams. Decreases in water flow will favour epifaunal species tolerant of reduced water flow over species that prefer high water flow rates, so that the composition of the epifaunal species will change. A decrease in water flow to negligible in the absence of wave induced water movement may result in a stagnant deoxygenated water (see deoxygenation) and increased siltation (see above). Although, *Limaria hians* probably produces a strong ventilation current for feeding it require water flow to remove waste products and provide adequate food. Therefore, a proportion of the population and the associated species

	may be lost and an intolerance of intermediate has been recorded. Recoverability is likely to be high (see additional information below).
Emergence regime changes - local increase	An increase or decrease in tidal emergence is unlikely to affect subtidal habitats, except that the influence of wave action and tidal streams may be increased (see water flow rate below).
Emergence regime changes - local decrease	An increase or decrease in tidal emergence is unlikely to affect subtidal habitats, except that the influence of wave action and tidal streams may be increased (see water flow rate below).
Wave exposure changes - local increase	This biotope has been recorded from extremely wave sheltered to wave exposed sites (JNCC, 1999). However, it probably occurs at greater depth with increasing wave exposure, since the effect of wave action on water movement decreases with depth (see Hiscock, 1983). The oscillatory nature of wave induced water movement is probably potentially damaging, especially where foliose macroalgae (e.g. kelps) attached to the carpet increase drag. The associated species will probably vary, favouring species more tolerant of wave exposure. However, an increase in wave exposure from e.g. moderately exposed to very exposed will probably result in disruption of the byssal carpet and mobilization of the substratum, especially in shallow representatives of the biotope. Therefore, the byssal carpet, its associated community and, hence the biotope, will probably be lost and an intolerance of high has been recorded. Recoverability would probably be low (see additional information below).
Wave exposure changes - local decrease	This biotope has been recorded from extremely wave sheltered to wave exposed sites (JNCC, 1999). Any further decrease in wave exposure is unlikely. The biotope would probably not be adversely affected as long as there was at least weak water flow (see above).
Water clarity increase	Decreased turbidity will result in increased light penetration, macroalgal growth and phytoplankton productivity, both of which may benefit *Limaria hians* and other suspension feeders by providing additional food. Increased macroalgal growth, especially red algae, may compete for space with epifaunal hydroids and bryozoans, resulting in a change in epifaunal species composition and increased abundance of algae, and potentially increased species richness. Where kelps are able to grow, the increased drag on the carpet may increase the biotopes intolerance to damage by increase in water flow or wave exposure. Nevertheless, the biotope would be little affected and an intolerance of low has been recorded. Recoverability is likely to be very high (see additional information below).
Water clarity decrease	Increased turbidity will reduce phytoplankton productivity and may reduce food availability for *Limaria hians* and other suspension feeders, however, most are probably capable of utilizing other organic particulates so that the effects would probably be sub-lethal. Increased turbidity will also decrease the depth to which kelps and other macroalgae can grow. Therefore, increased turbidity may decrease the occurrence of kelp and other macroalgae in examples of the biotope in which they occur, reducing species richness and the diversity of the habitat. However, the byssal carpet is unlikely to be affected, and an intolerance of low has been recorded. Recovery will depend on recolonization of available space by macroalgae and may be rapid in the case of red algae or take many years in the case of kelps (e.g. see *Laminaria hyperborea*).
Nutrient	Removal of the substratum would result in removal of the *Limaria hians* byssal

enrichment	carpet and the associated community. Therefore, an intolerance of high has been recorded. Recoverability would depend on recruitment from the surrounding area and subsequent growth of the *Limaria hians* population and its associated community, and has been assessed as low (see additional information below).
Habitat structure changes - removal of substratum (extraction)	Hall-Spencer & Moore (2000b) concluded that *Limaria hians* beds were intolerant to physical disturbance by mooring chains, hydraulic dredges or towed demersal fishing gear. Hall-Spencer & Moore (2000b) reported that a single pass of a scallop dredge at Creag Gobhainn, Loch Fyne ripped apart and mostly removed the *Limaria hians* reef. Damaged file shells were consumed by scavengers (e.g. juvenile cod *Gadus morhua*, whelks *Buccinum undatum*, hermit crabs *Pagurus bernhardus* and other crabs) within 24 hrs. Hall-Spencer & Moore (2000b) noted that although *Limaria hians* was able to swim, the shell was thin and likely to be damaged by mechanical impact. Damage of the *Limaria hians* carpet would probably result in exposure of the underlying sediment and exacerbate the damage resulting in the marked loss of associated species (Hall-Spencer & Moore, 2000b). Species with fragile tests such as *Echinus esculentus* and the brittlestar *Ophiocomina nigra* and edible crab *Cancer pagurus* were reported to suffer badly from the impact of a passing scallop dredge (Bradshaw et al., 2000). Scavenging species would probably benefit in the short term, while epifauna would be removed or damaged with the byssal carpet. Therefore an intolerance of high has been recorded. Severe physical disturbance would be similar to substratum removal in effect. Recoverability would probably be low (see additional information below).
Heavy abrasion, primarily at the seabed surface	Minchin (1995) reported that degradation of the *Limaria hians* bed resulted in patches of exposed shell-sand, destabilization of the sea bed and subsequent burial of surviving *Limaria hians*, which contributed to the decline of the bed. Smothering by 5 cm of sediment will probably prevent water flow through the intricate byssal nests of *Limaria hians*, preventing feeding and resulting in local hypoxia. *Limaria hians* is capable of swimming, and some individuals may be able to evacuate their nests. However, a proportion of the *Limaria hians* may be lost and an intolerance of intermediate has been recorded. Interstitial or infaunal species are unlikely to be adversely affected, although feeding may be interrupted and mobile species will avoid the effects. Loss of a proportion of the gaping file shell population and resultant degradation of the byssal carpet and loss of some associated epifauna, will result in the loss of species richness. Therefore, an intolerance of intermediate has been recorded. Recovery of the *Limaria hians* bed will depend on recruitment from outside the population and from survivors and is likely to be high (see additional information below).
Light abrasion at the surface only	
Siltation rate changes	An increase in suspended sediment levels may adversely affect suspension feeding species by clogging feeding and respiratory structures, and may result in increased siltation depending on water movement. Minchin (1995) suggested that *Limaria hians* was common in areas free of silt and mud. But *Limaria hians* beds have been recorded on muddy sand and gravel in wave sheltered areas with weak tidal streams such as lochs, and presumably subject to suspended sediment and siltation. The byssal nest probably protects the residents from the direct effects of siltation. Therefore, *Limaria hians* beds are probably tolerant of a variety of suspended sediment and siltation regimes. However, an increase in suspended sediment loads is likely to reduce feeding efficiency of suspension feeders including *Limaria hians* and increase energetic costs in the form of sediment rejection currents, mucus and pseudofaeces in the *Limaria hians*. The diversity of hydroids and bryozoans is likely to be reduced by siltation and the species composition of the biotope is

	likely to vary with suspended sediment loads. Overall, an intolerance of low has been recorded with a recoverability of very high.
	A decrease in suspended sediment may reduce the food availability for suspension feeding invertebrates. The species composition of associated epifaunal species is likely to vary with suspended sediment concentration, with sediment tolerant species being out-competed by fast growing but less sediment tolerant species as the suspended sediment concentration decreases. Overall, although the associated epifaunal species may change, and species richness decline temporarily, the *Limaria hians* carpet is unlikely to be adversely affected. Therefore, an intolerance of low has been recorded with a recoverability of very high.
	Limaria hians may be infested with 'oyster gill worms', trematodes of the genus Urastoma but they are considered to be harmless facultative commensals (Lauckner, 1983). *Limaria hians* may also act as secondary hosts for the metacercariae of digenean trematodes, which may cause sublethal effects or in extreme cases parasitic castration (Lauckner, 1983). Therefore, an intolerance of low has been recorded. Infected individuals may not recover although the population will probably recover rapidly.
Underwater noise changes	*Limaria hians* is not directly subject to extraction. However, Hall-Spencer & Moore (2000b) reported that a passing scallop dredge significantly damaged a *Limaria hians* bed in Loch Fyne due to physical disturbance (see above). Hall-Spencer & Moore (2000b) suggested that scallop dredging over the past 30 years was a likely cause of the decline in *Limaria hians* in the Clyde Sea, off the Isle of Man and other areas of the British coast. Therefore, an intolerance of low has been recorded. Recoverability is probably low (see additional information below).
Visual disturbance	*Limaria hians* has been recorded from the Lofoten Isles, Norway south to the Canary Isles and the Azores. Therefore, it is unlikely to be affected by long term changes in temperature at the benchmark level in British waters. Other members of the community may be adversely affected, for example boreal species (e.g. *Balanus crenatus* and *Modiolus modiolus*) may be replaced in the community by more southern species. In addition, reproduction and recruitment in echinoderms, and reproduction in hydroids and bryozoans are probably influenced by temperature (refer to species reviews). Overall, the species composition may vary but the gaping file shell carpet and hence the biotope will probably survive. The biotope is protected from extremes of temperature change by its subtidal habit. Therefore, an intolerance of low has been recorded to represent changes in species composition.
Introduction or spread of non-indigenous species.	*Limaria hians* has been recorded from the Lofoten Isles, Norway south to the Canary Isles and the Azores. Therefore, it is unlikely to be affected by long term changes in temperature at the benchmark level in British waters. Other members of the community may be affected, for example boreal species (e.g. *Balanus crenatus* and *Modiolus modiolus*) may increase in abundance. In addition, reproduction and recruitment in echinoderms, and reproduction in hydroids and bryozoans are probably influenced by temperature (refer to species reviews). Overall, the species composition may vary but the gaping file shell carpet and hence the biotope will probably survive. The biotope is protected from extremes of temperature change by its subtidal habit. Therefore, an intolerance of low has been recorded to represent changes in species composition.
Introduction of microbial pathogens	This biotope occurs in full salinity and is unlikely to encounter increases in salinity.

Removal of target habitat	This biotope occurs in weak to moderately strong tidal streams. An increase in water flow rate to strong or very strong is likely to physically damage the bed due to drag and modify the substratum in favour of coarser sediments, boulders and bedrock. The additional drag caused by emergent epifauna attached to the carpet, especially if kelps are present, is likely to cause the carpet to be removed in lumps. Holes in the carpet, may then allow mobilization of the sediment, resulting in further damage (see Minchin, 1995). Loss of the carpet will entail loss of the byssal carpet and its associated community, although individual gaping file shells will probably survive and be transported elsewhere (see displacement). Therefore, an intolerance of high has been recorded. Recoverability is likely to be low (see additional information below).
Removal of non-target habitat	This biotope occurs in weak to moderately strong tidal streams. Decreases in water flow will favour epifaunal species tolerant of reduced water flow over species that prefer high water flow rates, so that the composition of the epifaunal species will change. A decrease in water flow to negligible in the absence of wave induced water movement may result in a stagnant deoxygenated water (see deoxygenation) and increased siltation (see above). Although, *Limaria hians* probably produces a strong ventilation current for feeding it require water flow to remove waste products and provide adequate food. Therefore, a proportion of the population, and the associated species may be lost and an intolerance of intermediate has been recorded. Recoverability is likely to be high (see additional information below).

2.8	**Fragile Sponge and Anthozoan Communities MCR.ErSEun**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The biotope is found mainly in the south west of England and the west coast of Ireland. Long term increases in temperature may cause an increase in the abundance of the southern species that characterize it and more southern species may colonize the biotope. Expansion of the geographic range of the characterizing species may also expand the geographical range of the biotope northwards. In the case off an acute rise in temperature at the warmest time of year, it is not expected that temperature will be harmful as the characterizing species generally occur much further south than the British Isles. Overall, an increase in temperature is likely to be favourable to the presence of this biotope.
Temperature changes - local decrease	The distribution of the sponge *Axinella dissimilis* and the soft coral *Alcyonium digitatum* extend to Iceland so these species may be tolerant of long-term decreases in temperature. Long-term decrease in temperature is likely to lead to a poor year for recruitment of *Eunicella verrucosa* but is unlikely to lead to mortality. A live specimen collected from shallow depths off North Devon in 1973 exhibited growth rings that demonstrated that the colony had survived the 1962/63 cold winter. Also, large colonies were being collected from Lundy in the late 1960's suggesting no significant loss in 1962/63 (Keith Hiscock, own observations.). Assuming that temperature decrease reduces recruitment, the population size might decline for a year but recovery will occur following a successful recruitment. Therefore, it appears that the biotope may be able to tolerate a long term decrease in temperature. However, the response of these species to larger short term acute decrease are not known and may lead to a reduction in species diversity. Any losses are likely to be amongst species that recolonize rapidly. A rank of intermediate, but with very low confidence is reported.
Salinity changes - local increase	The biotope occurs only in fully saline waters (Connor et al., 1997a). The three selected key or important characterizing species are highly intolerant of decreases in salinity. Other characterizing species may also be highly intolerant of decreases in salinity. *Pentapora foliacea* has good reproductive and recolonizing abilities. It has been recorded as recovering in 3.5 years after almost total loss of a local population (Cocito et al., 1998(b)). *Eunicella verrucosa* is long lived, slow growing, and little is known of its reproduction. Sponges are often slow growing and long lived. Little is known of the reproduction and recruitment mechanisms in *Axinella dissimilis* or other sponges. Recovery of some parts of this community and biotope may take a long time. Other species are annuals and may have long-lived widely dispersing larvae. Many of the species in the biotope (including the 3 selected characterizing species) have permanent attachments to the substratum so immigration of adults into the biotope is not possible. Mobile species such as the echinoderms and fish may be able to return more rapidly.

Water flow (tidal current) changes - local increase	The biotope consists mainly of species firmly attached to the substratum and which would be unlikely to be displaced by an increase in the strength of tidal streams. Many of the species in this biotope are suspension feeders and rely to some extent on water flow to ensure their food supply. However, an increase in tidal flow rate to strong or greater (i.e. above 3 knots) may cause loss of posture and interfere with feeding mechanisms, particularly in the more delicate species like hydroids. Mobile species may be displaced or washed away but species such as the echinoderms and fish may be able to return rapidly after flow rates return to normal. There would be loss of feeding and a decline in species richness as mobile species might be swept away.
Water flow (tidal current) changes - local decrease	Many of the species in this biotope are suspension feeders and rely to some extent on water flow to ensure their food supply. Also, reduced water flow is likely to lead to siltation and therefore effects similar to those described in 'smothering'. Overall, the long-lived, slow growing and poor recruitment species are likely to survive albeit with reduced food supply and a small number of other species may succumb to smothering.
Emergence regime changes - local increase	The biotope is entirely subtidal and will not be subject to emergence.
Emergence regime changes - local decrease	The biotope is entirely subtidal and is not subject to emergence.
Wave exposure changes - local increase	The biotope exists in moderately exposed areas (Connor et al., 1997(a)). Increases in wave exposure may interfere with the posture of upright species in the biotope. Sea fans will be detached from the substratum by storms. For example, detached colonies are frequently seen on the seabed and after severe storms may be washed-up on the strandline. The surface of *Axinella dissimilis* cracks if bent more than 90° (Moss & Ackers, 1982). After prolonged easterly gales in the winter of 1987 at Lundy, branching sponges were damaged and some lost from monitoring sites (K. Hiscock pers. comm.). The erect bryozoan *Pentapora foliacea* has brittle lamellae and is known to be severely damaged by extreme wave action (Cocito et al., 1998(a)). The biotope MCR.PhaAxi occurs in more wave exposed areas although the effects of wave action would be reduced in the deeper waters in which the biotope occurs. Many of the species are sessile and attached to the substratum so supplementation of the population through immigration of adults is not possible. Mobile species such as the echinoderms and fish may be able to return more rapidly. *Pentapora foliacea* has some regenerative ability as well as good reproductive and recolonizing abilities. It has been recorded as recovering in 3.5 years after almost total loss of a local population (Cocito et al., 1998(b)). *Eunicella verrucosa* is long lived, slow growing, and little is known of its dispersal and reproduction. Little is known of the reproduction and recruitment mechanisms in *Axinella dissimilis* or other sponges. Some annual species such as *Nemertesia ramosa* are annuals and recruit readily over short distances. Providing that not all individuals of the characterizing species are lost during a storm, the biotope will remain but recovery to previous abundances in likely to take a long time so recovery is rated low.

Wave exposure changes - local decrease	Whilst water movement is required to bring food to suspension feeding species in the biotope, tidal streams are generally more important than wave oscillation in doing so . However, decreased wave e xposure may lead to in creased siltation and smothering effects. Therefore, some loss of species living close to the substrat um might o ccur. Those species ar e generally fast to sett le and grow.
Water clarity increase	Decreased turbidity is likely to lead t o increased algal growth with the potential to smother some of the species e specially where they live close to the se abed. Also, drift fr om ephemeral algae gr owing as a result of increased water clarity may clog branches of sea fans a nd branchin g sponges reducing fe eding ability. Effects of increased algal growth on this biotope have been observed at Lundy (Keith Hiscock, own observations) where the biotope and its component long lived, slow-growing and poorly recruiting components persisted . There effects are likely to be short-term and result in reduced feeding ability.
Water clarity decrease	The biotope occurs in t he circalittoral and none of the characterizing species are algae likely to be adversely affect ed by decreased ligh t levels. However, increased turbidity is usually caused by increased silt levels in the water so that the intolerance and recoverability characteristics are likely to be similar.
Non-synthetic compound contamination (incl. heavy metals)	Insufficient information
Non-synthetic compound contamination incl. hydrocarbons	Insufficient information
Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Insufficient information
Radionuclide contamination	Insufficient information
Nutrient enrichment	Insufficient information

Habitat structure changes - removal of substratum (extraction)	Most of the characteristic species in the biotope are permanently attached to the substratum (e.g. the sponges, sea fans and bryozoans) and will not re-attach once displaced. Substratum loss will result in loss of these species and so intolerance of the biotope is high. *Pentapora foliacea* has good reproductive and recolonizing abilities. It has been recorded as recovering in 3.5 years after almost total loss of a local population (Cocito et al., 1998b). *Eunicella verrucosa* is long lived, slow growing, and little is known of its reproduction. It is known to colonize wrecks at least several hundred metres from other hard substrata with sea fans, but is thought to have larvae which generally settle near the parent. Little is known of the reproduction and recruitment mechanisms in *Axinella dissimilis* or other sponges but branching sponges have not been observed to colonize wrecks and growth rate of *Axinella dissimilis* at Lundy is extremely slow (less than 1mm a year) (K. Hiscock, pers. comm.). In monitoring studies at Lundy, branching sponges showed no recruitment, only losses over a 13 year period (K. Hiscock pers. comm.). Recovery of some parts of this community may therefore take a long time or not occur. Other species in the biotope may have long-lived widely dispersing larvae. Mobile species such as the echinoderms and fish should be able to return rapidly.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	The three selected key or important characterizing species in this biotope are highly or intermediately intolerant of abrasion. Other species in the biotope that are upright and protrude above the substratum will also be damaged or killed by abrasion (e.g. hydroids, branching and cup sponges etc). Also, mobile surface species that are not fast movers, for example *Echinus esculentus*. *Pentapora fascialis* has good reproductive and recolonizing abilities. It has been recorded as recovering in 3.5 years after almost total loss of a local population (Cocito et al., 1998b). *Eunicella verrucosa* is long lived, slow growing, and little is known of its reproduction. Nevertheless, *Eunicella verrucosa* does appear to recruit well providing there are extant populations nearby. On the other hand, *Axinella polypoides* (one of the species often present in the biotope) is unlikely to recover if lost (Keith Hiscock, pers comm.). Sponges are often slow growing and long lived. Little is known of the reproduction and recruitment mechanisms in *Axinella dissimilis* or other sponges. Recovery of some parts of this community and biotope may take a long time. Other species are annuals and may have long-lived widely dispersing larvae. Many of the species in the biotope (including the 3 selected characterizing species) have permanent attachments to the substratum so immigration of adults into the biotope is not possible. Mobile species such as the echinoderms and fish will be able to return more rapidly.
Siltation rate changes	Some of the species in the biotope are upright and branching (e.g. *Axinella dissimilis* and *Eunicella verrucosa*). These species project above the substratum to sufficient height not to be covered completely by 5 cm of sediment and consequently may not be killed by smothering. Other more low lying or encrusting species (encrusting sponges, hydroids, bryozoans etc.) are more likely to be completely covered and will probably die. Many of the species are sessile and attached to the substratum so recovery of the population through immigration of adults is not possible. Mobile species such as the echinoderms and fish may be able to return more rapidly. *Pentapora fascialis* has some regenerative ability as well as good reproductive and recolonizing abilities. It has been recorded as recovering in 3.5 years after almost total loss of a local population (Cocito et al., 1998b). Some species such as *Nemertesia*

	ramosa are annuals and recruit readily over short distances. The long-lived slow growing and infrequently recruiting species are likely to survive smothering and the ones that are likely to be lost are also likely to recolonize within a few years. Recovery of the biotope as a whole is, however, likely to take more than five years. Therefore, a recovery rank of moderate is suggested.
	Many of the species are suspension feeders and increase in suspended sediment may cause interference and blockages, for example in sponge canals and pores. However, the anthozoans and sponges produce mucus which is shed with attached silt to clean the external surface. Mortality is not therefore expected with increased suspended sediment levels but some reduction in fitness may occur as a result of energy being expended in cleaning.
	Many of the species are suspension feeders and decrease in suspended sediment may reduce interference and blockages, for example of sponge canals and pores. However, the species in the biotope may rely of suspended organic material that is a part of the suspended material for feeding. Overall, there are both likely favourable and unfavourable effects of decrease in suspended sediment so that not sensitive is indicated.
Underwater noise changes	It is unlikely that any of the benthic key or important characterizing species are sensitive to noise disturbance. Some of the biotopes characterizing species, namely the wrasse (*Labrus bergylta*, *Labrus mixtus*), may have low intolerance to noise but this will not have a major impact on the biotope as a whole.
Visual disturbance	It is unlikely that any of the benthic key or important characterizing species are sensitive to visual presence. Some of the characterizing species in the biotope, namely the wrasse (*Labrus bergylta*, *Labrus mixtus*), may have low intolerance to visual disturbance but this will not have a major impact on the biotope as a whole.
Introduction or spread of non-indigenous species.	Insufficient information
Introduction of microbial pathogens	No information is directly available regarding the biotopes or the selected characterizing species tolerance to decreases in oxygenation. *Pentapora fascialis* and *Axinella dissimilis* have been assessed as of intermediate intolerance. Many of the species are sessile and attached to the substratum so supplementation of the population through immigration of adults is not possible. Mobile species such as the echinoderms and fish may be able to return more rapidly. *Pentapora foliacea* has some regenerative ability as well as good reproductive and recolonizing abilities. It has been recorded as recovering in 3.5 years after almost total loss of a local population (Cocito et al., 1998b). *Eunicella verrucosa* is long lived, slow growing, and little is known of its dispersal and reproduction. Little is known of the reproduction and recruitment mechanisms in *Axinella dissimilis* or other sponges. Some annual species such as *Nemertesia ramosa* are annuals and recruit readily over short distances. Recovery of the biotope as a whole is likely to take a long time.
Removal of target habitat	Insufficient information

Removal of non-target habitat	It is extremely unlikely that *Pentapora fascialis* would be targeted for extraction. However, *Eunicella verrucosa* is sometimes taken illegally (it is protected under schedule 5 of the Wildlife and Countryside Act 1981 against killing, injuring, taking possession and sale and is the subject of a UK Biodiversity Action Plan). *Echinus esculentus*, a characterizing species in the biotope, is also collected and an intolerance of intermediate has been suggested with a low recovery. If, however, the biotope was targeted indirectly for other species, the damage resulting from bottom fishing would be considerably more severe and this has been addressed under Physical Disturbance.

2.9	Horse Mussel Beds MCR.ModT
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	*Modiolus modiolus* is a boreal species reaching its southern limit in British waters (Holt et al., 1998). Davenport & Kjørsvik (1982) sug gested that its inability to tolerate temperature change was a factor preventing the horse mussel from colonizing the intertidal in the UK. Intertidal specimens were more common on no rthern Norwegian shore s (Davenpo rt & Kjørsvik, 1982). Little information on te mperature tolerance in *Modiolus modiolus* was found, however, its upper lethal temperature is lower than that for *Mytilus edulis* (Bayne et al., 1976) by about 4°C (Henderson, 1929; cited in Davenport & Kjørsvik, 1982). Su btidal populations are protected fro m major, short term changes in tempe rature by their depth. However, Holt et al. (1998) suggested that because *Modiolus modiolus* reaches its southern limit in British waters it ma y be s usceptible t o long term increases in summer water temperatures. Therefore, the absence of this species fro m the intertidal in the UK (with a few e xceptions) suggests that it is intolera nt of temperature change. The sugge sted susceptibility to lon g-term summer temperature rise could result in a reduction in the ext ent of the UK population a nd its associated community. Lower infralittoral to circalittor al populations are expo sed to a narrow ran ge of temperatures when compared t o the intertidal or eve n the shallow subtidal. Deep wat er species are therefore, like ly to be intolera nt of temp erature cha nge, especially short term acute chang e. For example, eight deep water red algae species had low er upper le thal temperatures than three shallo w water red algae (Kain & Norton, 1990). *Delesseria sanguinea* is tolerant of 23°C for a week (Lüning, 1984) but dies rapidly at 25°C. North Sea and Baltic specimens grew between 0-20°C, survived at 23°C but died rapidly at 25°C (Rietema, 1993). Rietema (1993) reported temperature differences in temperature tolerance between North Sea and Baltic specimens. Lüning (1990) reports optimal growth in *Delesseria sanguinea* between 10 - 15°C and optimal photosynthesis at 2 0°C. Howe ver, the upper limit of temperature tolerance in red algae reduced b y lowered salinity (Kain & Norton, 1990). Temperature is a cr itical fa ctor in stimulating or preventing hydroid reproduction an d most species exhibit an optimal range (Gili & Hughes, 1995). Bishop (1985) no ted that ga metogenesis in *Echinus esculentus* proceeded at temperatures between 11 - 19°C although continued e xposure to 19°C destroyed synchronicity of g ametogenesis between individuals. Bishop (1985) suggested that this species can not tolerate high temperat ures for p rolonged periods due to increased respiration r ate and resultant metabolic stress, suggest ing intoleran ce to acute temperature chan ge. However, *Echinus esculentus* is recorded fr om southern and northern British Isles suggesting tolerance of the temperature range found in the UK. Short term acute chan ges in temperature are noted to cause a r eduction in the loading of subcutan eous symbiotic bacter ia in echinoderms such as *Ophiothrix fragilis*. Reduct ions in these bacteria are probably indicative of le vels of stress and may lead to mortality (Newto n & McKenzie, 1995). However, the di stribution of *Ophiothrix fragilis* is lar ge,

	ranging from northern Norway south to the Cape of Good Hope. Consequently this species is exposed to temperatures both above and below those found in the British Isles. Overall, therefore, it is likely that a proportion of the horse mussel population and the associated community may be lost due to acute temperature change (see benchmark). Long term increases in temperature may reduce the populations range in the UK. Therefore, an intolerance of intermediate has been recorded. While, several members of the community are likely to recover within a few years, horse mussel recruitment is sporadic, varies with season, annually and with location and hydrographic regime and is generally low, therefore it may take many years for a population to recover from damage and a recoverability of low (10-25 years) has been recorded.
Temperature changes - local decrease	*Modiolus modiolus* is a boreal species reaching its southern limit in British waters (Holt et al., 1998). Lower infralittoral to circalittoral populations are exposed to a narrow range of temperatures when compared to the intertidal or even the shallow subtidal. Deep water species are therefore, likely to be intolerant of temperature change, especially short term acute change. Long term decreases in temperature could allow Modiolus beds and, therefore, the biotope to extend its range southwards. Other members of the community have a wide distribution in the north east Atlantic, although hydroids may be affected by decreased temperatures, especially short term acute changes. However, the biotope could potentially extend its range due to a decrease in temperature and 'not sensitive*' has been recorded. Short term acute change may remove members of the epifaunal community and a minor decline in species richness may result.
Salinity changes - local increase	This biotope (MCR. ModT) and those biotopes in has been used to represent, are found from the lower infralittoral and the circalittoral and are unlikely to be exposed to anything but full salinity.
Water flow (tidal current) changes - local increase	MCR.ModT occurs in tide swept locations in moderately strong to strong tidal streams. An increase in water flow may interfere with feeding in *Modiolus modiolus* since in flume studies the inhalant siphon closed by about 20% in currents above 55 cm/sec (Wildish et al., 2000). Similarly, fouling of the horse mussels increases their intolerance to dislodgement by strong tidal streams (Witman, 1985). Comely (1978) suggested that areas exposed to strong currents required an increase in byssus production, at energetic cost, and resulted in lower growth rates. Therefore, an increase in water flow rates to very strong may result in loss of a proportion of the population, depending on the size of the beds, the level of fouling or the nature of the substratum. Horse mussel beds on coarse or hard substrata may be less intolerant than beds on mobile, fine sediments. Epifauna such as hydroids may be damaged, or their feeding prevented by strong water flow (Gili & Hughes, 1995). The characterizing hydroids may be replaced by hydroid species more tolerant of strong water flow such as *Tubularia indivisa*. Brittlestars such as *Ophiothrix fragilis* may be swept away by increased water flow, e.g. above a certain water speed (25 cm/s) the feeding arms are withdrawn from the water column (Warner & Woodley, 1975; Hiscock, 1983). At water speeds above about 28 cm/s individuals or even small groups may be displaced from the substratum and they have been observed being rolled along the seabed by the current (Warner, 1971). Living in dense aggregations may reduce displacement of

	brittlestars by strong currents (Warner & Woodley, 1975) and living within crevices in the horse mussel beds will presumably also provide some protection. Sea urchins, such as *Echinus esculentus*, are known to be swept away by strong currents and, although not killed, may be removed from the community and unable to return until water flow rates return to prior conditions. Overall, therefore a proportion of the horse mussel population may be removed, together with several members of the community and an intolerance of intermediate has been recorded. The biotopes SCR.ModCvar and SCR.ModHAs may be more intolerant of dislodgement due to there muddy substratum. The associated community will probably change from species tolerant of siltation and low water flow to species tolerant of higher water flow, perhaps coming to resemble MCR.ModT. Horse mussel recruitment is sporadic, highly variable and some areas receive little or no recruitment for several years (see additional information below). Therefore, a recoverability of low has been recorded.
Water flow (tidal current) changes - local decrease	Flume experiments suggested that Modiolus sp. can deplete the seston directly over dense beds when water flow is low, resulting in a reduction in the density of the mussel bed (Wildish & Kristmanson, 1984, 1985: Holt et al., 1998). *Alcyonium digitatum* prefers areas of high water flow, and its abundance may decline in reduced water flow. Brittle stars such as *Ophiothrix fragilis* are passive suspension feeders and require water flow to supply them with food particles. A reduction in water flow may reduce food availability, however *Ophiothrix fragilis* can survive considerable loss of body mass during reproductive periods (Davoult et al., 1990) so restricted feeding may be tolerated, and this species is found in sheltered areas of reduced water flow. Hydroids and bryozoans also require water flow to provide them with food particles but hydroid species in deeper water, with generally less water movement, have higher biomass, are larger and longer-lived than in shallower waters. Therefore, a reduction in water flow may reduce the density of the horse mussel bed, and may change the associated community favouring species that prefer low water flow. The biotope MCR. ModT may come to resemble the sheltered horse mussels beds (SCR. ModCvar or SCR. ModHAs). In addition, in the sheltered biotopes decreased water flow will increase the risk of deoxygenated conditions (see below). Overall, therefore, an intolerance of intermediate has been recorded. Horse mussel recruitment is sporadic, highly variable and some areas receive little or no recruitment for several years (see additional information below). Therefore, a recoverability of low has been recorded.
Emergence regime changes - local increase	Most of the species identified as indicative of intolerance may be of 'intermediate' or 'high' intolerance to desiccation and emergence regime, including *Modiolus modiolus*. Hydroids especially are also likely to be highly intolerant. However, this biotope (MCR.ModT) and those biotopes it has been used to represent, is found from the lower infralittoral and the circalittoral and in unlikely to be exposed to the air.
Emergence regime changes - local decrease	Decreased emersion is unlikely to adversely affect this biotope (or those it has been chosen to represent) and may allow members of the biotope to feed longer and improve condition, i.e. the biotope may benefit. The biotope could possibly extend its range, although the rates of increase in bed size are likely to be slow, probably longer than the benchmark level.

Wave exposure changes - local increase	An increase in wave exposure may result in increased oscillatory movement at the seabed, which can be a destructive force (Hiscock, 1983). Comely (1978) suggested that in areas of strong water flow horse mussels increased byssus production. *Mytilus edulis* was shown to increase byssus production in response to agitation (Young, 1985) and *Modiolus modiolus* may respond similarly, so that increased wave action may be resisted. Populations on mobile sediment may be removed by strong wave action due to removal or changes in the substratum. No information concerning storm damage was found. Epifauna such as hydroids may be damaged, or their feeding prevented by strong water flow (Gili & Hughes, 1995). The characterizing hydroids may be replaced by hydroid species more tolerant of strong water flow such as *Tubularia indivisa*. Brittlestars such as *Ophiothrix fragilis* may be swept away by increased water flow, e.g. above a certain water speed (25 cm/s) the feeding arms are withdrawn from the water column (Warner & Woodley, 1975; Hiscock, 1983). At water speeds above about 28 cm/s individuals or even small groups may be displaced from the substratum and they have been observed being rolled along the seabed by the current (Warner, 1971). Living in dense aggregations may reduce displacement of brittlestars by strong currents (Warner & Woodley, 1975) and living within crevices in the horse mussel beds will presumably also provide some protection. Sea urchins, such as *Echinus esculentus*, are known to be swept away by strong currents and, although not killed, may be removed from the community and unable to return until calmer conditions return. Overall, therefore a proportion of the horse mussel population may be removed, together with several members of the community and an intolerance of intermediate has been recorded. The biotopes SCR.ModCvar and SCR.ModHAs may be more intolerant of dislodgement due to their muddy substratum. The associated community will probably change from species tolerant of siltation and low water low to species tolerant of higher water flow, perhaps coming to resemble MCR.ModT. Horse mussel recruitment is sporadic, highly variable and some areas receive little or no recruitment for several years (see additional information below). Therefore, a recoverability of low has been recorded.
Wave exposure changes - local decrease	Tidal flow rather than wave action is the predominant force in feeding, so that wave action is most important in relation to the potential destruction of beds. Providing that tidal flows remains reasonably strong, horse mussel beds may benefit from a reduction in wave action and a rank of 'not sensitive*' is suggested. Decreased wave action may allow horse mussel beds to extend into shallower depths, however, the rates of increase in bed size are likely to be slow, probably much longer than the benchmark level.

Water clarity increase	*Modiolus modiolus* is found in turbid to clear waters (Holt et al., 1998). Decreases in turbidity may increase phytoplankton productivity and therefore, potentially increase food availability for the horse mussels and other suspension feeding epifauna. Increased light availability will benefit red algae, promoting growth but may reduce the abundance of hydroids by interfering with settlement, or due to competition for space with red algae (Kain & Norton, 1990; Gili & Hughes, 1995). Red algae may increase in abundance. Increased growth of algae, especially kelps, may increase the horse mussel beds vulnerability to dislodgement by strong water flow, depending on the level of grazing by sea urchins in particular (Witman, 1985). Therefore, increased fouling is likely to impair feeding and hence reproduction in horse mussels and an intolerance of low has been recorded. However, in the absence of sufficient grazing, fouling by foliose algae, especially kelps may result in dislodgement of a proportion of the mussel bed (Witman, 1985). Recovery will depend on reduction in red algae and colonization by other epifauna such as bryozoans or hydroids, which likely to be rapid, depending on local conditions and the proximity of adult colonies.
Water clarity decrease	*Modiolus modiolus* is found in turbid to clear waters (Holt et al., 1998). Increased turbidity may decrease phytoplankton primary productivity and hence the food supply for the horse mussel. However, Navarro & Thompson (1996) concluded that the horse mussel was adapted to an intermittent and often inadequate food supply. However, other suspension feeding species may be affected by the reduced food availability, e.g. *Ophiothrix fragilis*, however this species can survive loss of body mass during reproductive periods and is likely to survive reduced food availability. *Alcyonium digitatum* will be unaffected in the factor changes during its quiescent period (late July - December) and will probably survive during the rest of the year, although is reproductive capacity may be reduced. While encrusting coralline algae are particularly tolerant of low light conditions, increased turbidity is likely to adversely affect foliose red algae. Although shade tolerant, a decrease in light intensity, comparable to the benchmark level, is likely to reduce photosynthesis, reduce growth and affect reproduction. Increased turbidity, is therefore likely to result in loss of red algae from this biotope. However, other epifauna may benefit as a result, e.g. hydroids may increase in abundance, size and diversity. Algal grazers such as gastropods and chitons may be lost from the biotope if no alternative food sources are available. Therefore, there will be losses for some species and gains for others and an intolerance of low has been recorded due to the intolerance of red algae within the biotope. Recoverability will depend on recolonization by red algae once turbidity returns to previous or tolerable levels e.g. *Delesseria sanguinea* was reported to recolonize cleared blocks within 56-59 days in one experiment and 41 weeks (8 months) in another depending on depth and spore availability (Kain, 1975). Therefore a recoverability of high has been recorded.

Habitat structure changes - removal of substratum (extraction)	Removal of the substratum would result in the loss of the *Modiolus modiolus* bed and its associated community. Therefore, an intolerance of high has been recorded. The epifaunal organisms such as anthozoans, hydroids, barnacles, ascidians and brittlestars are likely to take some time to recolonize but could potentially recover within five years. However, *Modiolus modiolus* beds are likely to take considerable time the recolonize and to develop into a bed similar in size and in the diversity and species richness they support (see additional information below). Therefore, a recoverability of very low has been recorded.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	*Modiolus modiolus* are large and relatively tough. Holt et al. (1998) suggested that horse mussel beds were not particularly fragile, even when epifaunal, with semi-infaunal and infaunal population being less vulnerable to physical disturbance. Clumps of horse mussels of muddy substrata may be more intolerant. However, impacts from towed fishing gear (e.g. scallop dredges) are known to flatten clumps and aggregations, may break off sections of raised reefs and probably damage individual mussels (Holt et al., 1998). The shells of older specimens can be very brittle due to infestations of the boring sponge *Cliona celata* (Comely, 1978; Holt et al., 1998). Holt et al., (1998) suggested that scallop dredging on areas adjacent to beds in the south east of the Isle of Man had 'nibbled away at the edges' of dense beds, which had become less dense and more scattered. Extensive beds were present to the north of the Isle of Man where scallop dredging had apparently not occurred (Holt et al., (1998). Magorrian & Service (1998) reported that queen scallop trawling resulted in flattening of the horse mussel bed and disruption of clumps of horse mussels and removal of emergent epifauna in Strangford Lough. They suggested that the emergent epifauna such as *Alcyonium digitatum* were more intolerant than the horse mussels themselves and reflected early signs of damage but were able to identify different levels of impact from impacted but largely intact to heavily trawled areas with few *Modiolus modiolus* intact, lots of shell debris and little epifauna (Service & Magorrian, 1997; Magorrian & Service, 1998; Service 1998). Veale et al., 2000 reported that the abundance, biomass and production of epifaunal assemblages, including *Modiolus modiolus* and *Alcyonium digitatum* decreased with increasing fishing effort. Species with fragile hard tests such as echinoids are known to be intolerant of scallop dredges (see Eleftheriou & Robertson, 1992; Veale et al., 2000). Scavengers such as *Asterias rubens* and *Buccinum undatum* were reported to be fairly robust to encounters with trawls (Kaiser & Spencer, 1995) may benefit in the short term, feeding on species damaged or killed by passing dredges. However, Veale et al. (2000) did not detect any net benefit at the population level. Scallop dredging was found to damage many of the epibenthic species found in association with Modiolus beds (Hill et al., 1997 ; Jones et al., 2000). Holt et al. (1998) suggested that damage by whelk potting was not likely to be severe but also noted that epifaunal populations may be more intolerant. Disruption of the clumps or beds may result in loss of some individual horse mussels suggesting an intolerance of intermediate, however, given the intolerance of epifauna suggested above an overall intolerance of high is recorded. Horse mussel recruitment is sporadic, varies with season, annually and with location and hydrographic regime and is generally low, therefore it may take many years for a population to

	recover from damage and a recoverability of low (10-25 years) has been recorded.
Siltation rate changes	Holt et al., (1998) point out that the deposit of spoil or solid wastes (e.g. from capital dredging) that settle as a mass will smother any habitat it lands on. MCR.ModT beds usually occur in areas of moderate to strong water flow (Holt et al., 1998) where accretion is probably reduced. Biogenic reef formation involves the build up of faecal mud, suggesting that adults can move up through the accreting mud to maintain their relative position within the growing mound. However, no information on natural accretion rates was found. Holt et al. (1998) note that there are no studies of the accretion rates that *Modiolus modiolus* beds can tolerate. Therefore, smothering by 5cm of sediment for a month (the benchmark level) is likely to remove a proportion of the horse mussel population. Red algae such as *Delesseria sanguinea* and *Phycodrys rubens* are probably large enough to tolerate smothering by 5cm of sediment, and encrusting coralline algae would probably survive under sediment for one month (see benchmark). *Ophiothrix fragilis* and *Balanus crenatus* are likely to be smothered by 5cm of sediment, and are not able to crawl up through the sediment. Hydroids are likely to be intolerant of smothering and siltation (see below), e.g. *Sertularia operculata* were reported to have died when covered by a fine layer of silt during periods of low water movement (Gili & Hughes, 1995). Therefore, a proportion of the horse mussel population and its associated community may be lost due to smothering and an intolerance of intermediate has been recorded. Hydroids and brittle stars may be more intolerant, therefore, species richness is likely to decline. Recruitment is sporadic, highly variable and some areas receive little or no recruitment for several years (see additional information below). Therefore, a recoverability of low has been recorded.
	Modiolus modiolus is found in a variety of turbid and clear water conditions (Holt et al., 1998). Muschenheim & Milligan (1998) noted that the height of the horse mussels beds in the Bay of Fundy positioned them within the region of high quality seston while avoiding high levels of re-suspended inorganic particulates (2.5-1500mg/l) at the benthic boundary layer. Comely (1978) noted that a population in a high turbidity area (up to 14mg/l inorganic suspended particulates) showed excessive pearl formation and poor shell growth and condition, although the populations poor condition was probably partly due to old age and senility. Infaunal communities are probably exposed to high levels of suspended sediment at intervals (depending on variation in water flow and storms). Therefore, although high levels of suspended sediment may interrupt feeding, or result in the production of pseudofaeces at energetic cost, *Modiolus modiolus* is probably able to tolerate increases in suspended sediment for intervals equivalent to the benchmark and an intolerance of low has been recorded. Increases in organic suspended particulates may increase food availability and be beneficial. Horizontal surfaces in the subtidal tend to be algal dominated (where illumination permits) with animal dominated communities occurring on vertical or steep slopes (Hartnoll, 1983). However, the species identified as indicative of intolerance were assessed as 'low' intolerance to increase suspended sediment and siltation. Increased suspended sediment may clog or interfere with filter feeding or

	suspension feeding apparatus, which would require an energetic cost to clear. However, suspension feeders may benefit from an increase in organic particulates. Hydroids may be particularly intolerant e.g. *Sertularia operculata* were reported to have died when covered by a fine layer of silt during periods of low water movement (Gili & Hughes, 1995). In areas of strong tidal flow where the biotope MCR.ModT is found, an increase suspended sediment may not result in a significant increase in siltation. Therefore, since the indicative species were of low intolerance to increases in suspended sediment an overall biotope intolerance of low has been recorded but a decline in species richness is likely due to loss of epifaunal hydroids. However, the biotopes SCR.ModCvar and SCR.ModHAs may be more intolerant of increased suspended sediment due to an increase in siltation in sheltered habitats. Most suspension feeders are likely to recover rapidly, however, a recoverability of very high has been recorded to represent the time required for hydroids to recover their original abundance or extent.
	A decrease in suspended sediment may decrease the food availability for *Modiolus modiolus* and other suspension feeding species. However, Navarro & Thompson (1996) demonstrated that *Modiolus modiolus* was adapted to seasonal fluctuations in food availability, reducing feeding activity in winter and increasing feeding activity during the summer phytoplankton bloom, for which it had a high absorption efficiency. Similarly, *Ophiothrix fragilis* has a low respiration rate and can tolerate considerable loss of body mass during reproductive periods (Davoult et al., 1990) so that restricted feeding may be tolerated. Therefore, *Modiolus modiolus* is unlikely to be adversely affected by a decrease in suspended sediment for a month (see benchmark). Overall, therefore, suspension feeders within the biotope may suffer reduced growth or condition due to reduced food availability and an intolerance of low has been recorded. Red algae may benefit from reduced suspended sediment due to reduced turbidity (see below).
Introduction or spread of non-indigenous species.	Brown & Seed (1977) reported a low level of infestation (ca 2%) with pea crabs *Pinnotheres* sp. in Port Erin, Isle of Man and Strangford Lough. Comely (1978) reported that ca 20% of older specimens, in an ageing population, were damaged or shells malformed by the boring sponge *Cliona celata*. Infestation by the boring sponge reduces the strength of the shell and may render the population more intolerant of physical disturbance (see above). However, little other information concerning the effects of parasites or disease on the condition of horse mussels was found. *Echinus esculentus* is susceptible to 'Bald-sea-urchin disease', which causes lesions, loss of spines, tube feet, pedicellariae, destruction of the upper layer of skeletal tissue and death. Bald sea-urchin disease was recorded from *Echinus esculentus* on the Brittany coast. Although associated with mass mortalities of *Strongylocentrotus franciscanus* in California and *Paracentrotus lividus* in the French Mediterranean it is not known if the disease induces mass mortality (Bower, 1996). However, no evidence of mass mortalities of *Echinus esculentus* associated with disease have been recorded in Britain and Ireland. Loss of sea-urchins may be detrimental to the horse mussel bed due to fouling (see ecological relationships). Evidence of sub-lethal effects alone was found in *Modiolus modiolus* and an intolerance of low has been recorded.

Introduction of microbial pathogens	Theede et al. (1969) examined the relative tolerance of gill tissue from several species of bivalve to exposure to 0.21mg/l O_2 with or without 6.67mg of sulphide (at 10°C and 30psu). *Modiolus modiolus* tissue was found to be the most resistant of the species studied, retaining some ciliary activity after 120hrs compared with 48hrs for *Mytlius edulis*. While it is difficult to extrapolate from tissue resistance to whole animal resistance (taking into account behavioural adaptations such as valve closure) this suggests that horse mussels are more, or at least similarly, tolerant of hypoxia and hydrogen sulphide to the common mussel. In addition, most bivalve molluscs exhibit anaerobic metabolism to some degree. Therefore, *Modiolus modiolus* was assessed as of low intolerance at the benchmark level. However, *Alcyonium digitatum*, *Ophiothrix fragilis* and *Delesseria sanguinea* were assessed as highly intolerant of deoxygenation, while *Echinus esculentus* was regarded as of intermediate intolerance. Hydroids mainly inhabit environments in which the oxygen concentration usually exceeds 5 ml/l and respiration is aerobic. Assimilation of oxygen occurs simply by diffusion through the epidermis of exposed tissues and transport to tissues is facilitated by hydroplasmic flow and ciliary activity (Hickson, 1901). *Ophiothrix fragilis* was known to have a low respiration rate (Migné & Davoult, 1997b), particularly during colder winter temperatures, however, extreme hypoxia was reported to cause mass mortality (Stachowitsch, 1984). The effects of deoxygenation in plants has been little studied and since plants produce oxygen they may be considered relatively insensitive. However, a study of the effects of anaerobiosis (no oxygen) on some marine algae concluded that *Delesseria sanguinea* was very intolerant of anaerobic conditions; at 15°C death occurred within 24hrs and no recovery took place although specimens survived at 5°C (Hammer 1972). Under hypoxic conditions echinoderms become less mobile and stop feeding. Death of a bloom of the phytoplankton *Gyrodinium aureolum* in Mounts Bay, Penzance in 1978 produced a layer of brown slime on the sea bottom. This resulted in the death of fish and invertebrates, including *Echinus esculentus*, presumably due to anoxia caused by the decay of the dead dinoflagellates (Griffiths et al., 1979). Although the horse mussels are probably tolerant of hypoxic condition, all the species indicative of intolerance were more intolerant, suggesting that the epifauna and epiflora would decrease in abundance or diversity under hypoxic conditions. Therefore, an overall intolerance of intermediate has been recorded. Recovery would depend on growth of surviving epifauna, or re-colonization and would probably require up to 5 years (see additional information below).
Removal of target habitat	No information concerning non-native species competitors was found.
Removal of non-target habitat	Holt et al. (1998) reported that, although there was no large scale horse mussel fishery in the United Kingdom, there have been small scale local fisheries in Scotland for food or bait and that horse mussels were occasionally seen on markets in Lancashire. Holt et al. (1998) suggested that any direct fishery would be very damaging. Horse mussels, *Modiolus modiolus*, are the key species within this biotope (MCR. ModT) and the biotopes it has been used to represent. Extraction of *Modiolus modiolus* would have severe consequences for the associated community. Scallop

	beds are known to be associated with or occur in the vicinity of *Modiolus modiolus* beds (Holt et al., 1998; Magorrian & Service, 1998). Holt et al. (1998) suggested that horse mussel beds were not particularly fragile, even when epifaunal, with semi-infaunal and infaunal population being less vulnerable to physical disturbance from fishing activity. Clumps of horse mussels of muddy substrata may be more intolerant. However, impacts from towed fishing gear (e.g. scallop dredges) are known to flatten clumps and aggregations, may break off sections of raised reefs and probably damage individual mussels (Holt et al., 1998). Holt et al. (1998) suggested that scallop dredging on areas adjacent to beds in the south east of the Isle of Man had 'nibbled away at the edges' of dense beds, which had become less dense and more scattered (Holt et al., 1998). Extensive beds were present in the north of the Isle of Man where scallop dredging has apparently not occurred (Holt et al., (1998). Magorrian & Service (1998) reported that queen scallop trawling resulted in flattening of horse mussel beds and disruption of clumps of horse mussels and removal of emergent epifauna in Strangford Lough. They suggested that the emergent epifauna such as *Alcyonium digitatum* were more intolerant than the horse mussels themselves and reflected early signs of damage. They were able to identify different levels of impact from impacted but largely intact beds to heavily trawled areas with few *Modiolus modiolus* intact, lots of shell debris and little epifauna (Service & Magorrian, 1997; Magorrian & Service, 1998; Service 1998). Veale et al. (2000) reported that the abundance, biomass and production of epifaunal assemblages, including *Modiolus modiolus* and *Alcyonium digitatum* decreased with increasing fishing effort. Scallop dredging was found to damage many of the epibenthic species found in association with Modiolus beds (Hill et al., 1997; Jones et al., 2000). Scavengers such as *Asterias rubens* and *Buccinum undatum* were reported to be fairly robust to encounters with trawls (Kaiser & Spencer, 1995) and may benefit in the short term, feeding on species damaged or killed by passing dredges. However, Veale et al. (2000) did not detect any net benefit at the population level. In addition, *Buccinum undatum* may itself be the subject of a fishery, although its removal may not adversely affect the biotope. Species with fragile hard tests such as echinoids are known to be intolerant of scallop dredges (see Eleftheriou & Robertson, 1992; Veale et al., 2000). Removal of sea urchins may have adverse effects of the horse mussel beds due to increased fouling and potential dislodgement or loss of clumps of mussels. Recovery will depend on recruitment of horse mussels and subsequent development of the beds, which may take many years (see additional information below). Brown (1989; cited in Ramsay et al., 2000) suggested that fishing activities may render the habitat unsuitable for recolonization by species such as *Modiolus modiolus*. The epifaunal organisms such as anthozoans, hydroids, barnacles, ascidians and brittlestars are likely to take some time to recolonize but could potentially recover within five years. However, *Modiolus modiolus* beds are likely to take considerable time the recolonize and to develop into a bed similar in size and in the diversity and species richness they support (see additional information below). Therefore, a recoverability of very low has been recorded.

2.10	**Inshore deep mud and burrowing heart urchin community: Cmu.BriAchi**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	In shallower locations e.g. sea lochs, sedimentary biotopes typically experience seasonal changes in temperature of about 10°C (5-15°C) (Hughes, 1998b) and it is likely that the CMU.BriAchi community would be tolerant of a long term chronic temperature increase. For most offshore burrowing species, temperature changes in the water column are likely to be buffered by the insulation offered by the substratum and the depth of overlying water. Furthermore, a temperature increase may enhance growth and fecundity. Muus (1981) showed that juvenile *Amphiura filiformis* are capable of much higher growth rates in experiments with temperatures between 12 and 17°C (unlimited food supply). Juvenile disc diameter increased from 0.5 to 3.0 mm in 28 weeks under these conditions compared to over 2 years in the North Sea. Mean summer temperatures of 14°C and an apparent abundant food supply may also account for the early rapid growth of *Amphiura chiajei* in Killary Harbour (Munday & Keegan, 1992). In *Brissopsis lyrifera*, processes such as mobility, sediment turnover and remineralization may increase (K. Hollertz, pers. comm., Hollertz & Duchêne, 2001). Hollertz & Duchê (2001) found that in *Brissopsis lyrifera*, the amount of reworked sediment due to burrowing almost doubled from 14 to 22 ml/l sediment per hour when the temperature increased from 7 to 13°C. This temperature increase also saw the amount of ingested sediment increase from 0.02 to 0.08 g dry sediment per hour. However, increased water temperature may enhance microbial decomposition within the substratum and promote deoxygenation, to which *Brissopsis lyrifera* is intolerant. Owing to the fact that the biotope is subtidal, where wide and rapid variations in temperature, such as those experienced in the intertidal, are not common, the community is likely to be more intolerant of an acute temperature increase of 5°C and intolerance has been assessed to be intermediate. Recovery has been assessed to be high since members of the community are likely to remain to revitalize the population (see additional information below).
Temperature changes - local decrease	In shallower locations e.g. sea lochs, sedimentary biotopes typically experience seasonal changes in temperature of about 10°C (5-15°C) (Hughes, 1998b) and it is likely that the CMU.BriAchi community would be tolerant of a long term chronic temperature decrease. For most offshore burrowing species temperature changes in the water column are likely to be buffered to some extent by the insulation offered by the substratum and the depth of overlying water. However, burrowing itself has been found to be significantly affected by temperature in *Brissopsis lyrifera*. Hollertz & Duchêne (2001) found that *Brissopsis lyrifera* reworked almost half the amount of sediment per hour at 7°C compared to activity at 14°C. Furthermore, *Brissopsis lyrifera* maintains a continuous contact with the overlying water column through the funnel (Hollertz, 2002). Also, the biotope community seems to be periodically affected by severe winters. During the winter of 1962-1963 a few dead *Nephrops norvegicus* were caught in the North Sea, although the majority were caught alive (Crisp, 1964). Mean densities of *Amphiura chiajei* in Killary Harbour, west coast of Ireland, decreased following months with the lowest recorded bottom temperatures, 4°C and 6°C, for February 1986 and January 1987 respectively.

	Intolerance of the acute change and depressed temperatures on the part of some of the older individuals probably led to their demise (Munday & Keegan, 1992). Low temperatures are also a limiting factor for breeding which occurs in the warmest months in the UK. Temperature tolerances of *Brissopsis lyrifera* are unknown but low water temperatures have caused mass mortalities of other similar echinoderms, such as *Echinocardium cordatum*. In the severe winter of 1962-63 masses of dead *Echinocardium cordatum* were observed in regions of the North Sea and English Channel, although it was reported that living specimens were obtained easily enough by digging (Crisp, 1964). Therefore, intolerance has been assessed to be intermediate as key species within the community appear to be periodically degraded by acute decreases in temperature. Recovery has been assessed to be high, as members of the community remain to revitalize the population.
Salinity changes - local increase	The biotope CMU.BriAchi is found within fully marine subtidal locations and it is highly unlikely that the biotope would experience conditions of hyper salinity and in this instance the factor is considered not relevant. However, it is likely that key components of the biotope community would be intolerant of an increase in salinity. For instance, echinoderms such as *Brissopsis lyrifera* and *Amphiura chiajei* are stenohaline owing to the lack of an excretory organ and a poor ability to osmo- and ion-regulate causing body fluid to decrease when individuals are exposed to higher salinity (Stickle & Diehl, 1987).
Water flow (tidal current) changes - local increase	The presence of the biotope is determined by a low energy hydrodynamic regime facilitating the deposition of cohesive fine silts and clays. Following an increase in water flow rate only the surface sediments are likely to be winnowed away in a unidirectional flow. The lower substratum inhabited by mature specimens of *Brissopsis lyrifera* and *Amphiura chiajei* is likely to remain unchanged. However, the settlement of the planktonic larvae of these key species may be inhibited owing to re-suspension along with particulate matter. Consequently the viability of the population may be reduced. Furthermore the deposit feeding community may experience a reduction in food availability owing to reduced deposition of organic matter. Intolerance to increased water flow rate has been assessed to be intermediate. On return to prior conditions, specimens of the characterizing species will have remained and are likely to repopulate via successful larval settlement. However, attainment of a fully diverse community is likely to take several years and recovery has been assessed to be moderate (see additional information below).
Water flow (tidal current) changes - local decrease	The presence of the biotope is determined by a low energy hydrodynamic regime facilitating the deposition of fine silts and clays, hence the community is not likely to be directly intolerant of a decrease in water flow rate. Sediments may become muddier owing to increased settlement of particulate matter. However, as deposit feeders are the dominant trophic group such additional material may be utilizable as a food resource and the community may benefit indirectly.
Emergence regime changes - local increase	The biotope only occurs in the circalittoral zone (below 10m) and is not likely to be subjected to a change in emergence regime.
Emergence regime changes -	The biotope only occurs in the circalittoral zone (below 10m) and is not likely to be subjected to a change in emergence regime.

local decrease	
Wave exposure changes - local increase	The CMU.BriAchi biotope occurs offshore and in sheltered near shore habitats where wave exposure is negligible, so the biotope is probably very intolerant of increased wave exposure. However, the factor is only likely to affect the biotope where it occurs at depths of less than 60m, as the effects of wave action are attenuated with depth. Wave action resulting from storms may disturb the surface sediment. McIntosh (1875) reported specimens of *Amphiura chiajei* thrown on to West Sands, St. Andrews Bay after storms. Over the duration of a year increased wave exposure is likely to cause the substratum character to drastically alter, as wave action would penetrate the substratum to a greater depth, and become outside the habitat preference of the species. The community would no longer occur at that location. Intolerance has therefore been assessed to be high. Once fine sediments have been removed it would take a very long time for a suitable substratum to reform so recovery has been assessed to be very low.
Wave exposure changes - local decrease	The CMU.BriAchi biotope occurs offshore and in sheltered near shore habitats where wave exposure is already negligible, so a reduction in wave exposure is not likely to have a direct impact upon the biotope community and intolerance has been assessed to be low.
Water clarity increase	The community is unlikely to be directly intolerant of increased light penetration of the water column caused by a decrease in turbidity. Greater light penetration of the water column may improve primary production by phytoplankton in the water column and contribute to secondary productivity via the production of detritus from which the community may benefit. For other related but indirect effects see decrease in suspended sediment above.
Water clarity decrease	The community is unlikely to be directly intolerant of the light attenuating effects of an increase in turbidity, however, for other related but indirect effects, see suspended sediment above. In the long term, increased turbidity may affect primary production by the microphytobenthos on the substratum surface depleting food availability. Furthermore, increased turbidity may hinder predation by visual predators such as *Nephrops norvegicus*, dab *Limanda limanda*, haddock *Melanogrammus aeglefinus* upon *Amphiura chiajei*, which provides an important link between the benthic and pelagic realms. There may be some increased energetic costs experienced by certain species, associated with increased turbidity, but effects are not likely to be significant and so intolerance has been assessed to be low. Recoverability is likely to be very high on return to conditions prior to the impact.
Habitat structure changes - removal of substratum (extraction)	Species within the CMU.BriAchi biotope are infaunal and will be lost if the substratum is removed so the overall intolerance of the biotope has been recorded as high. Although some species are mobile e.g. *Calocaris macandreae* and *Nephrops norvegicus*, if disturbed they are likely to seek refuge within a burrow within the substratum and so are also likely to be removed. The characterizing species do not reach sexual maturity for several years and recovery has been assessed to be moderate (see additional information below).
Heavy abrasion, primarily at	The CMU.BriAchi biotope can be affected by fishing activity in areas such as the northern Irish Sea, where the community may also contain *Nephrops norvegicus* (Mackie et al., 1995). In areas of the North Sea where heavy

the seabed surface	demersal fishing for *Nephrops norvegicus* occurs, populations of *Brissopsis lyrifera* are likely to be reduced owing to damage inflicted to the 'test' by the fishing gear . Broken tests may be seen on the seabed (E.I.S. Rees, M. Costello, pers comm. to Connor et al., 1997). Similar evidence has been reported for other heart urchins. For example, Houghton et al. (1971), Graham (1955), de Groot & Apeldoorn (1971) and Rauck (1988) refer to significant trawl-induced mortality of heart urchin *Echinocardium cordatum*. A substantial reduction in the numbers of the species due to physical damage from scallop dredging has been observed (Eleftheriou & Robertson, 1992). Bergman & van Santbrink (2000) suggested that *Echinocardium cordatum* was one of the most vulnerable species to trawling. Bradshaw et al. (2000) suggested that fragile species such as urchins (e.g. *Spatangus purpureus* and *Echinus esculentus*), suffered badly from impact with a passing scallop dredge. Overall, species with brittle, hard tests are regarded to be sensitive to impact with scallop dredges (Kaiser & Spencer, 1995; Bradshaw et al., 2000). Brittlestars have fragile arms that are likely to be damaged by abrasion or physical disturbance. *Amphiura chiajei* burrows in the sediment and extends its arms across the sediment surface to feed. Ramsay et al., (1998) suggests that Amphiura species may be less susceptible to beam trawl damage than other species of echinoid or tube dwelling amphipods and polychaetes. Bergman & Hup (1992) for example, found that beam trawling in the North Sea had no significant direct effect on small brittlestars. Bradshaw et al. (2002) noted that the brittlestars *Ophiocomina nigra*, *Ophiura albida* and *Amphiura filiformis* had increased in abundance in a long-term study of the effects of scallop dredging in the Irish Sea. Brittlestars can tolerate considerable damage to arms and even the disc without suffering mortality and are capable of disc and arm regeneration so their recovery is likely to be rapid. Deeper burrowing crustaceans such as *Calocaris macandreae* may occasionally be displaced from burrow openings by towed gear (Atkinson, 1989). During long term monitoring of fishing disturbance on the Northumberland coast Frid et al. (1999) observed a decrease in the numbers of sedentary polychaetes, echinoid echinoderms and large (>5 cm) brittlestars. Therefore, while brittlestars may increase in abundance in the long term, the dominant heart urchin species is likely to be reduced in abundance and an intolerance of intermediate has been recorded. Recovery is likely to be high, as members of the community are likely to remain and be able to repopulate. *Brissopsis lyrifera* may not regenerate as well as the brittle star (K. Hollertz, pers. comm.).
Light abrasion at the surface only	
Siltation rate changes	The biotope will probably have a low intolerance to smothering by 5 cm of sediment because the characterizing species are all infaunal burrowers. There may be some energetic cost expended to either re-establish burrow openings in the case of *Calocaris macandreae* and *Nephrops norvegicus*, or to self-clean feeding apparatus though this is not likely to be significant. The biotope is likely to be more intolerant of smothering by viscous or impenetrable materials e. g. smothering by sediment of a coarser texture may affect burrowing and feeding. At the benchmark level, recovery of the community from smothering is assessed to be immediate.

	Suspension feeders are not found within the biotope so clogging of feeding apparatus by suspended sediment is not a consideration. *Brissopsis lyrifera*, *Amphiura chiajei*, *Calocaris macandreae* and *Turritella communis* are burrowing infauna and non-selective surface and sub-surface deposit feeders. For most benthic deposit feeders, food is suggested to be a limiting factor for body and gonad growth, at least between events of sedimentation of fresh organic matter (Hargrave, 1980; Tenore, 1988). Consequently, an increase in the suspended matter settling out from the water column to the substratum may increase food availability. This suggests that an increase in siltation may be beneficial and the biotope is not considered to be sensitive.
	A decrease in the suspended sediment and hence siltation will reduce the flux of particulate material to the seabed. Since this includes organic matter the supply of food to the biotope would probably also be reduced. However, the benchmark states that this change would only occur for one month and therefore a decrease in siltation would be unlikely to cause a significant alteration to species composition. Therefore intolerance has been assessed to be low.
Introduction or spread of non-indigenous species.	The only major biological agent known to affect a species in this biotope is the dinoflagellate parasite, *Hematodinium* sp., now prevalent in *Nephrops norvegicus* populations from the west of Scotland, Irish Sea and North Sea. The *Hematodinium* parasite occurs in the blood and connective tissue spaces and appears to cause death in the host by blocking the delivery of oxygen to the host's tissues (Taylor et al., 1996). Heavily-infested animals become moribund, spend more time out of their burrows and are probably less able to evade capture by predators or fishing gear. However, the ecological consequences of this infestation are unknown but evidence to date suggests that the Nephrops stocks have not been seriously affected (Hughes, 1999b). The occurrence of the ascothoracidan parasite *Ulophysema öresundense* (Brattström) has been observed in the body cavity of *Brissopsis lyrifera* (Brattström, 1946). This parasite may cause sexual castration but no further information concerning the effect of this parasite on the population was found.
Removal of target habitat	There are no records of any non-native species invading the biotope and it is considered not to be relevant.
Removal of non-target habitat	Neither *Brissopsis lyrifera* nor *Amphiura chiajei* are targeted for collection or harvesting. However, *Nephrops norvegicus*, one of the species indicative of sensitivity, is the target of a large commercial fishery. Findings from the western Irish Sea suggest that the structure of some Nephrops populations may render them vulnerable to over-exploitation (Hughes, 1998(b). During the spring and summer a gyre (circulating water mass) forms, which coincides with the period when Nephrops larvae are present in the plankton. The gyre retained the larvae in the vicinity of the parent population, rather than being carried off by currents into areas of unsuitable substratum (Hill et al., 1997; Hill et al., 1996). The retention of larvae by the gyre may be essential for the maintenance of the local Nephrops population and it is possible that over-exploitation of Nephrops in this area could lead to a self-perpetuating population decline owing to a reduction in recruitment. In a study on the effects of otter trawling for *Nephrops norvegicus* on the benthos of locations in the Irish Sea and Scottish sea lochs, Ball et al., (2000) reported a reduction in the abundance of large-bodied and fragile organisms such as *Brissopsis lyrifera* and *Amphiura chiajei* and suggested that these species are particularly intolerant of trawling disturbance. An altered but stable community resulted,

	comprising of fewer species and reduced faunal diversity, consisting primarily of small polychaetes. In areas of the North Sea where heavy demersal fishing for *Nephrops norvegicus* occurs, populations of *Brissopsis lyrifera* are likely to be reduced owing to damage inflicted to the 'test' by the fishing gear. Broken tests may be seen on the seabed (E.I.S. Rees, M. Costello, pers comm. to Connor et al., 1997). Similar evidence has been reported for other heart urchins. For example, Houghton et al. (1971), Graham (1955), de Groot & Apeldoorn (1971) and Rauck (1988) refer to significant trawl-induced mortality of heart urchin *Echinocardium cordatum*. A substantial reduction in the numbers of the species due to physical damage from scallop dredging has been observed (Eleftheriou & Robertson, 1992). Bergman & van Santbrink (2000) suggested that *Echinocardium cordatum* was one of the most vulnerable species to trawling. Bradshaw et al. (2000) suggested that fragile species such as urchins (e.g. *Spatangus purpureus* and *Echinus esculentus*), suffered badly from impact with a passing scallop dredge. Overall, species with brittle, hard tests are regarded to be sensitive to impact with scallop dredges (Kaiser & Spencer, 1995; Bradshaw et al., 2000). Brittlestars have fragile arms that are likely to be damaged by abrasion or physical disturbance. *Amphiura chiajei* burrows in the sediment and extends its arms across the sediment surface to feed. Ramsay et al., (1998) suggests that Amphiura species may be less susceptible to beam trawl damage than other species of echinoid or tube dwelling amphipods and polychaetes. Bergman & Hup (1992) for example, found that beam trawling in the North Sea had no significant direct effect on small brittlestars. Bradshaw et al. (2002) noted that the brittlestars *Ophiocomina nigra*, *Ophiura albida* and *Amphiura filiformis* had increased in abundance in a long-term study of the effects of scallop dredging in the Irish Sea. Brittlestars can tolerate considerable damage to arms and even the disc without suffering mortality and are capable of disc and arm regeneration so their recovery is likely to be rapid. Deeper burrowing crustaceans such as *Calocaris macandreae* may occasionally be displaced from burrow openings by towed gear (Atkinson, 1989). During long term monitoring of fishing disturbance on the Northumberland coast Frid et al., (1999) observed a decrease in the numbers of sedentary polychaetes, echinoid echinoderms and large (> 5 cm) brittlestars. Therefore, while some authors have reported that brittlestars may increase in abundance in the long term, the dominant heart urchin species is likely to be reduced in abundance. Following the evidence of Ball et al. (2000), a high intolerance has been recorded. Recovery is likely to be moderate (see additional information), as members of the community are likely to remain and be able to repopulate. *Brissopsis lyrifera* may not regenerate as well as the brittle star (K. Hollertz, pers. comm.).

2.11	Intertidal mudflats: Lmu.HedMac
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The intolerance of the biotope to an increase in temperature is largely dependent on the sensitivities of the important characterizing species. Both *Hediste diversicolor* and *Macoma balthica* occur in southern Europe and therefore must be able to become acclimated to higher temperatures than experienced in Britain and Ireland. Furthermore, they live infaunally in sediment with a high water content and hence are insulated against temperature change. Oertzen (1969) recorded that *Macoma balthica* could tolerate temperatures up to 49°C before thermal numbing of gill cilia occurred presumably resulting in death. Ratcliffe et al. (1981) reported that *Macoma balthica* from the Humber Estuary, UK, tolerated 6 hours of exposure to temperatures up to 37.5°C with no mortality. It seems likely therefore that the species could adapt to a chronic change and tolerate a large acute change with no mortality. Bartels-Hardege & Zeeck (1990) demonstrated that sub-lethal temperature increases resulted in disruption of spawning in *Hediste diversicolor*, with potential adverse consequences on recruitment success. Despite, the apparent tolerance of the important characterizing species, there may be sublethal effects of temperature increase and biotope intolerance is assessed as low. These effects should be rapidly overcome when temperatures are restored to their original levels and so recoverability is assessed as very high. There is evidence that other species in the biotope are intolerant of temperature increase. For example, Sommer et al. (1997) reported a critical upper temperature of 20°C for *Arenicola marina*, above which the species resorts to anaerobic respiration, and noted that North Sea specimens could not acclimate to a 4°C increase above this temperature. For *Cerastoderma edule*, Wilson (1981) reported a median lethal temperature of 29°C for 96 hours exposure and along with Smaal et al. (1997) commented on the species' limited ability to acclimate to changes in temperature. An acute temperature increase may therefore result in a minor decline in species richness in the biotope.
Temperature changes - local decrease	Both of the important characterizing species in the biotope appear to be very tolerant of low temperatures. *Macoma balthica* occurs in the Gulfs of Finland and Bothnia where the sea freezes for several months of the year (Green, 1968) and was apparently unaffected by the severe winter of 1962/3 which decimated populations of many other bivalve species (Crisp, 1964). Furthermore, De Wilde (1975) noted that *Macoma balthica* kept at 0°C maintained a high level of feeding activity. *Hediste diversicolor* was also apparently unaffected by the winter of 1962/63 (Crisp, 1964). The biotope is therefore assessed as 'not sensitive'. Other species in the biotope, however, are more intolerant of decreases in temperature, e.g. *Cerastoderma edule* and *Arenicola marina*, and there may be a minor decline in species richness.

Salinity changes - local increase	The biotope occurs in fully saline conditions (Connor et al., 1997b) so is unlikely to be affected by increases in salinity. The reaction of a number of species to hypersaline conditions (>40 psu) has been studied. McLusky & Allan (1976) reported that *Macoma balthica* failed to grow at 41 psu. Rygg (1970) noted that a population of *Cerastoderma edule* did not survive 23 days exposure at 60 psu, although they did survive at 46 psu. When exposed to hyper-osmotic shock (47 psu), *Arenicola marina* lost weight, but were able to regulate and gain weight within 7-10 days (Zebe & Schiedek, 1996).
Water flow (tidal current) changes - local increase	The biotope occurs in areas such as estuaries (Connor et al., 1997b) where water flow rate is likely to be weak. An increase in water flow rate would change the sediment characteristics in which the biotope occurs, primarily by re-suspending and preventing deposition of finer particles (Hiscock, 1983). The underlying sediment in the biotope has a high mud content; a substratum which would be eroded in very strong tidal streams. Therefore, the infaunal species, such as *Hediste diversicolor* and *Macoma balthica*, would be outside their habitat preferences and some mortality would be likely to occur. For example, Green (1968) recorded that towards the mouth of an estuary where sediments became coarser and cleaner, *Macoma balthica* was replaced by another tellin species, *Tellina tenuis*. Additionally, the consequent lack of deposition of particulate matter at the sediment surface would reduce food availability for the deposit feeders in the biotope. The resultant energetic cost over one year would also be likely to result in some mortality. Species such as *Macoma balthica* and *Hediste diversicolor*, which are able to vary their feeding methods, may react to the change by switching to suspension feeding. A biotope intolerance of intermediate is recorded and species richness is expected to decline. Recoverability is assessed as high (see additional information below).
Water flow (tidal current) changes - local decrease	The biotope occurs in areas such as estuaries (Connor et al., 1997b) where water flow rate is likely to be weak. The characterizing species thrive in low energy environments, are primarily deposit feeders and are capable of generating their own feeding and respiration currents. As a result of decreased water flow, rate of siltation is likely to increase, making conditions more favourable for deposit feeders. Indeed, Newell (1965) (cited in Green, 1968) noted that *Macoma balthica* populations in the Thames Estuary, UK, were denser where the grade of deposit was finer, possibly due to greater food availability. The biotope is therefore unlikely to be affected by a decrease in water flow rate.
Emergence regime changes - local increase	The majority of the species in the biotope, including the important characterizing species, live infaunally in mud or muddy sand, and are therefore protected from the short term stresses of an increase in emergence regime. However, over time the increased emergence would be likely to result in an energetic cost due to reduced feeding opportunities. Many of the species in the biotope would be able to relocate to their preferred position on the shore. *Macoma balthica*, for example, is mobile and able to relocate in the intertidal by burrowing (Bonsdorff, 1984) or floating (Sörlin, 1988), and *Hediste diversicolor* is an active burrower, swimmer and crawler. No mortality of the important characterizing species is expected, but the energetic cost of lost feeding opportunities and relocation results in an intolerance assessment of low. The energetic cost would be quickly overcome when the emergence regime returns to normal so recoverability is assessed as very high. Less mobile species, such as the bivalves, *Cerastoderma edule* and *Mya arenaria*, would be expected to suffer some mortality.

Emergence regime changes - local decrease	The biotope occurs on the lower shore and its characterizing species are all found in the shallow subtidal. Therefore, it is unlikely that the biotope would be intolerant of a decrease in emergence regime. Decreased emergence may allow the biotope to become established further up the shore, but not where the habitat is constrained by sea defences (Elliott et al., 1998).
Wave exposure changes - local increase	LMU.HedMac occurs in low energy environments categorized as 'sheltered' to 'extremely sheltered' on the wave exposure scale (Connor et al., 1997 b). This suggests that the biotope would be intolerant of wave exposure to some degree. An increase in wave exposure by two categories for one year would be likely to affect the biotope in several ways. Fine sediments would be eroded (Hiscock, 1983) resulting in the likely reduction of the habitat of the infaunal species, e.g. *Hediste diversicolor* and *Macoma balthica*, and a decrease in food availability for deposit feeders. Strong wave action is likely to cause damage or withdrawal of delicate feeding and respiration structures of species within the biotope resulting in loss of feeding opportunities and compromised growth. Furthermore, species may be damaged or dislodged by scouring from sand and gravel mobilized by increased wave action. For example, Ratcliffe et al. (1981) reported that juvenile *Macoma balthica* are susceptible to displacement by water currents due to their small mass and inability to bury deeply. It is likely that some mortality would result and therefore an intolerance of intermediate is recorded. Recoverability is recorded as high (see additional information below). Macroalgae and species with delicate feeding structures, such as the polychaete *Aphelochaeta marioni*, are likely to be particularly vulnerable to increases in wave exposure and would probably be lost from the biotope completely. Species richness is therefore expected to decline.
Wave exposure changes - local decrease	LMU.HedMac occurs in low energy environments categorized as 'sheltered' to 'extremely sheltered' on the wave exposure scale (Connor et al., 1997 b). It is unlikely that a further decrease in wave exposure would have any appreciable effect on the biotope.
Water clarity increase	A decrease in turbidity will mean more light is available for photosynthesis by macroalgae, phytoplankton in the water column and microphytobenthos on the sediment surface. This would increase the primary production in the biotope and may mean greater food availability for suspension feeders and deposit feeders. There may be a consequent proliferation of epifauna and macroalgae at the expense the previously dominant infauna. *Macoma balthica* and *Hediste diversicolor* may react to the proliferation of phytoplankton by switching to suspension feeding.

Water clarity decrease	LMU.HedMac occurs in relatively turbid waters and therefore the species in the biotope are likely to be well adapted to turbid conditions. An increase in turbidity may affect primary production in the water column and therefore reduce the availability of diatom food, both for suspension feeders and deposit feeders. In addition, primary production by the microphytobenthos on the sediment surface may be reduced, further decreasing food availability for deposit feeders. However, primary production is probably not a major source of nutrient input into the system and, furthermore, phytoplankton will also immigrate from distant areas so the effect may be decreased. As the benchmark turbidity increase only persists for a year, decreased food availability would probably only affect growth and fecundity of the intolerant species so a biotope intolerance of low is recorded. As soon as light levels return to normal, primary production will increase and hence recoverability is recorded as very high. Where they occur, the macroalgae in the biotope are likely to be most affected by an increase in turbidity and may be eliminated, resulting in a minor decline in species richness.
Habitat structure changes - removal of substratum (extraction)	The majority of the species in the biotope are infaunal and would therefore be removed along with the substratum. This would result in loss of entire populations and therefore intolerance is assessed as high and species richness would experience a major decline. Recoverability is assessed as high (see additional information below).
Heavy abrasion, primarily at the seabed surface	The infaunal polychaetes in the biotope, including *Hediste diversicolor*, have a fragile hydrostatic skeleton, and are therefore vulnerable to damage by physical abrasion. An anchor dragging at the sediment surface may damage fragile feeding structures and/or penetrate the soft substratum sufficiently to impact the infauna. The bivalves in the biotope, although more robust, are also vulnerable to physical abrasion. For example, damage caused by mechanical harvesting has been reported in *Cerastoderma edule* (Pickett, 1973; Cotter et al., 1997). It is likely that some mortality would occur and therefore intolerance is assessed as intermediate, although species richness would be unlikely to decline. Recoverability is recorded as high (see additional information below).
Light abrasion at the surface only	
Siltation rate changes	The important characterizing species in the biotope are infaunal and capable of burrowing. Smith (1955) noted that when a population of *Hediste diversicolor* was covered with several inches of sand, the worms burrowed through the additional material and showed no adverse reaction. *Macoma balthica* is also a mobile species and is able to burrow upwards and surface from a depth of 5-6 cm (Brafield & Newell, 1961; Brafield, 1963; Stekoll et al., 1980). It is possible that there would be an energetic cost related to the infauna relocating to their preferred depth and so intolerance is assessed as low. The energetic cost would be short lived so recoverability is assessed as very high. Ephemeral algae in the biotope would be smothered by a 5cm layer of sediment and therefore, where they were present beforehand there would be a minor decline in biotope species richness.

	The dominant and characterizing species in the biotope (*Macoma balthica* and *Hediste diversicolor*) are infaunal and display plasticity in their feeding methods (McLusky & Elliott, 1981; Nielsen et al., 1995). They are primarily deposit feeders but are able to switch to suspension feeding when conditions allow. Neither species are therefore likely to be adversely affected by changes in siltation as they would be able to employ the feeding method most appropriate for the environmental conditions. An increase in suspended sediment would result in an increased rate of siltation and therefore an increased food supply for deposit feeders. The important characterizing species may therefore increase in abundance if food had been previously limiting. The species most likely to be adversely affected by an increase in suspended sediment are the obligate suspension feeders such as *Cerastoderma edule* and *Mya arenaria*. The feeding and respiration structures risk becoming clogged thus potentially impairing growth and reproduction (Grant & Thorpe, 1991; Navarro & Widdows, 1997). Increased siltation would also have a negative effect on macroalgae where present, by blocking out incident light. There may therefore be a minor decline in species richness in the biotope.
	The majority of species in the biotope are either suspension feeders or deposit feeders and therefore rely on a supply of nutrients in the water column and at the sediment surface. A decrease in the suspended sediment would result in decreased food availability for suspension feeders. It would also result in a decreased rate of deposition on the substratum surface and therefore a reduction in food availability for deposit feeders. This would be likely to impair growth and reproduction. The benchmark states that this change would occur for one month and therefore would be unlikely to cause mortality. Furthermore, the dominant and characterizing species in the biotope (*Macoma balthica* and *Hediste diversicolor*) display plasticity in their feeding methods (McLusky & Elliott, 1981; Nielsen et al., 1995) and therefore are adapted to utilizing whatever food source is available. An intolerance of low is therefore recorded. When suspended sediment levels revert to their original levels, feeding activity would quickly return to normal and hence recoverability is recorded as very high.
Introduction or spread of non-indigenous species.	*Hediste diversicolor* is parasitized by the coccidian, *Coelotropha durchoni*, but apparently does not suffer mortality (Porchet-Hennere & Dugimont, 1992). *Macoma balthica* is parasitized by *Lacunovermis macomae* (Lebour) and the trematode, *Parvatrema affinis* which is known to cause sexual castration (Swennen & Ching, 1974). Some mortality is therefore likely and intolerance is assessed as intermediate. Recoverability is recorded as high (see additional information below).
Removal of target habitat	There is no evidence to suggest that the biotope may be colonized by non-native species.

Removal of non-target habitat	*Hediste diversicolor* is extracted by bait diggers (Anon, 1999). However, very little information was found concerning the effect of this extraction and it is not possible to assess biotope intolerance further than saying that a proportion of the target species would be removed. In general, bait harvesting may have a negative effect on intertidal benthic habitats. For example, mechanical harvesting for *Arenicola marina* resulted in drastic reduction in the population of *Mya arenaria* in the Wadden Sea (Beukema, 1995), and commercial digging of mudflats in Maine, USA, reduced total number of infaunal taxa (Brown & Wilson, 1997). Intolerance has been assessed as intermediate to reflect the likelihood that various species will experience some loss. Recoverability is assessed as high (see additional information below).

2.11	**Intertidal mudflats LMs.MS**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Many intertidal species are adapted to temperature extremes, can alter metabolic activity, burrow deeper in sediment or move to deeper water. Thermal discharges may increase growth of bivalves and fish, increase phytoplankton production (Clark, 1997) and may alter the extent of populations. Temperature change is known to affect the number of generations per year of *Corophium volutator* and an increase in temperature may increase reproduction in *Corophium volutator*. In general, the number of species is likely to be highest during summer (M. Kendall, pers. comm.). Beukema (1990) stated that he was unaware of any soft-bottom species that were sensitive to high summer temperatures and, overall, tolerant has been suggested.
Temperature changes - local decrease	Many intertidal species are adapted to temperature extremes, can alter metabolic activity, burrow deeper in sediment or move to deeper water. Although adapted to temperature change, severe change may result in seasonal reduction in species richness and abundance. Temperature may also affect microbial activity and microphytobenthic primary production. Beukema (1990) studied the effects of changing winter temperatures on zoobenthos over a 20 year period in the Wadden Sea. More than one third of macrobenthic infauna were found to be sensitive to cold winters. Species that were unable to move long distances, such as polychaetes and bivalves, probably died whereas the crustacea probably moved offshore. No *Lanice conchilega*, *Abra tenuis*, *Mysella bidentata* or *Angulus tenuis* were found to survive the coldest winter (in which temperatures fell below -10°C for about one week and below freezing for up to ca four weeks) and the numbers of *Cerastoderma edule*, *Nephtys hombergii*, *Crangon crangon* and *Carcinus maenas* were severely depleted. Even in 'cold' winters, where the temperature only fell below –10°C on a couple of days, survival was very low among these species and again, no *Lanice conchilega* survived. Crisp (1964a) also reported that all intertidal *Lanice conchilega* were killed in the severe winter of 1962-63 but that some survived subtidally. At a community level, the impact was found to be more serious on lower tidal flats than on higher ones since the former contained a higher proportion of species less adapted to extremes in temperature. Fish and bird species feeding on the

	macrobenthos will experience a reduction in food availability over the winter months. In cold periods waders and other shore birds have increased energy demands for thermoregulation and require greater food intake and, therefore, are more intolerant of additional disturbance. Bird species with a wider range of prey species will be more tolerant of fluctuations in invertebrate numbers than species with narrow prey preferences. It is possible that many species will experience a decline in abundance in the case of an acute fall in temperature and accordingly, an intolerance of intermediate has been recommended. However, recoverability is likely to be high. Beukema (1990) found that after a severe winter, recovery of the previous biomass and species richness occurred within one or two years and recruitment was generally higher after the cold winter. However, most of the species could be found in large numbers subtidally and recruitment was possible from nearby via mobile larval stages or immigration of adults.
Salinity changes - local increase	LMS.MS can occur in areas of full salinity and, therefore, are thought to be tolerant to an increase in salinity.
Water flow (tidal current) changes - local increase	The nature of the substratum is, in part, determined by the hydrographic regime including water flow rate. Changes in the water flow rate will change the sediment structure and have concomitant effects on the community. Channel modification or seasonal changes in riverine runoff, especially in estuaries, may remove low water areas of mud or sand flats. Furthermore, increased water flow rate may mean that some species have to re-burrow more frequently which would adversely effect the energy budget of some infauna. An increase in water flow rate may lead to the removal of the upper layer of fine silty sediment in muddier sediments. Over the course of one year, there may be some habitat loss and accordingly, intolerance has been assessed as high. Recoverability is expected to be high on return to former conditions.
Water flow (tidal current) changes - local decrease	A decrease in water flow rate is likely to result in the accumulation of sediment. The effects of such a change will depend on the existing sediment. If the sediment is characterized by clean sand, a decrease in flow rate may result in the settlement of finer silt particles. Over the course of one year this is likely to affect the community structure although the resultant community would still be described as LMS. MS. Species richness has been described as not relevant since a change in species composition would not necessarily result in a decline in species richness. Intolerance has been assessed as low to reflect community change. Recovery is expected to be very high.
Emergence regime changes - local increase	Increased emergence (e.g. by tidal and storm surge barrages) is likely to increase the desiccation of the sediment, especially at the top of the shore, and may allow terrestrial plants, such as pioneer saltmarsh species e.g. Salicornia sp. or Spartina spp. to invade. Species richness will most likely decline and favour species more tolerant of desiccation or burrowing species. Providing suitable substratum was available, the extent of the biotopes may extend further down shore but in general, the upper extent of the biotope is expected to decrease and intolerance has been assessed as intermediate. Recovery is expected to be high (see additional information).

Emergence regime changes - local decrease	Decreased emergence, for example due to sea level rise or barrages, may move the high water mark further up shore but this is not possible in the presence of sea defenses. The low water mark moves inshore, effectively reducing the area available for intertidal invertebrates and the area in which birds can feed, so called 'coastal squeeze'. The construction of a storm surge barrier at Oosterschelde resulted in loss of 33% of the intertidal habitat and reduced populations of birds dependant on mudflats for feeding (Meire, 1993; Elliot et al., 1998). Resultant increased water depth changes infaunal feeding types and increases the area available to predatory fish. Changes in predator influence will result in a change in the structure of the benthic community and may lead to a shift in species dominance. At most, and depending on the location, there is likely to be a change in species composition and, although the resultant community may still be characteristic of muddy sand shores, some species may be lost. The biotopes may start to develop into other biotopes such as IMS.EcorEns or IMS.MacAbr but, overall, intolerance has been assessed intermediate to reflect the likelihood the loss of biotope at its lower shore extent. Recoverability is likely to be high on return to previous levels of emergence.
Wave exposure changes - local increase	Storms and intense wave action may move or remove substrata in shallow subtidal or intertidal sedimentary habitats. For example, in shallow subtidal muddy sands in Liverpool Bay, Eagle (1973) reported significant fluctuations in the abundance of dominant species (e.g. *Abra alba*, *Lanice conchilega* and *Lagis koreni*) resulting from wash out during storms. Recolonization occurred rapidly and depended on the availability of larvae in the plankton and redistribution of juveniles or adults by bedload transport (Eagle, 1975; Hall, 1994). Similar observations were reported for *Lagis koreni* and *Abra alba* in the intertidal muddy sands and mobile offshore sands of Red Wharf Bay, Anglesey and the surrounding coast (Rees et al., 1977). Increased wave action will disrupt feeding, burrowing, reduce species abundance, richness and biomass (Elliot et al., 1998). The strength of wave action determines the topography, steepness and shore width of the intertidal, e.g. large areas of surface mud were removed from Severn estuary by exposure to prevailing gales and its large tidal range (Ferns, 1983, cited in Elliot et al., 1998). Changes in wave exposure would change the sediment granulometry and the sediment will become coarser which, although smaller animals find it easier to move through, will result in reduced food availability (M. Kendall, pers. comm.). Muddy sands are typical of sheltered locations and may be particularly intolerant to increased wave exposure. Long term change may favour littoral gravel and sand communities. Intolerance has been assessed as high. Recoverability is likely to be low (see additional information).
Wave exposure changes - local decrease	The strength of wave action determines the topography, steepness and shore width of the intertidal (Elliot et al., 1998). Changes in wave exposure would change the sediment granulometry and the sediment will become finer. Although this will result in increased food availability, suspension feeders are intolerant of sediment increases in silt/clay content and, therefore, the proportion of suspension feeders may decrease in favour of deposit feeders. Long term change may favour littoral mud communities and a high intolerance has been suggested. Recoverability is likely to be low (see additional information).

Water clarity increase	A decrease in turbidity may enhance primary production. For the suspension feeders and deposit feeders feeding on settled phytoplankton, this will mean an increase in available food. Tolerant *, has therefore been suggested although species richness is not expected to rise.
Water clarity decrease	An increase in turbidity may limit primary productivity from phytoplankton and microphytobenthos. However, the majority of productivity in these communities is secondary (detritus). Incoming tides and wave action resuspend sediment in passing, resulting in high local turbidity. Turbidity in estuaries is often high, measured in g/l. Therefore the microphytobenthos is probably adapted to high turbidity and capable of taking advantage of light availability at low tide. Tolerant has been suggested.
Habitat structure changes - removal of substratum (extraction)	Although intertidal dredging may only occur at a few sites where LMS.MS has been recorded, sedimentary communities are likely to be highly intolerant of substratum removal, which will lead to partial defaunation, exposure of the underlying sediment and changes in the topography of the area (Dernie et al., 2003). In addition, heart urchins, molluscs and crustaceans are likely to be damaged or killed in dredging operations (Elliot et al., 1998). Dredging operations were shown to affect large infaunal and epifaunal species, decrease sessile polychaetes and reduce the abundance of burrowing heart urchins. Species living in the top layer of the sediment will be removed and subsequently perish. The remaining species, given their new position at the sediment / water interface, may be exposed to conditions to which they are not suited, i.e. unfavourable conditions. Newell et al. (1998) state that removal of 0.5 m depth of sediment is likely to eliminate benthos from the affected area. Dredging activities may result in deep pits or trenches between 0.5 m - 20 m deep depending on the techniques used (Newell et al., 1998). Hall (1994) reported that suction dredging for Ensis species in 7 m of water in a Scottish sea loch resulted in pits in the sediment and significant reductions in the abundance of a large proportion of the species at the experimental site. However, no differences in species abundances between the impacted plots and controls were detectable after 40 days. This rapid recovery was probably due to intense wave and storm activity during the experimental period that transported sediment and animals in suspension and in bedload transport (Hall, 1994). In the intertidal, mechanical cockle harvesting resulted in significant losses of common invertebrates in muddy sand and clean sand in the Burry Inlet (Ferns et al., 2000). For example, losses varied from 31% of *Scoloplos armiger* to 83% of *Pygospio elegans*. Populations of *Nephtys hombergii* and *Scoloplos armiger* took over 50 days to recover. However, recovery was more rapid in clean sand than in muddy sand. In muddy sand, *Bathyporeia pilosa* took 111 days to recover while *Pygospio elegans* and *Hydrobia ulvae* had not recovered their original abundance after 174 days (Ferns et al., 2000). Recoverability will depend on the time taken for the substratum to return to prior conditions, pits or trenches to fill and recolonization to occur. The recoverability of LMS.MS is likely to be high (see additional information).
Heavy abrasion, primarily at the seabed surface	In the intertidal, mechanical cockle harvesting resulted in significant losses of common invertebrates in muddy sand and clean sand in the Burry Inlet (Ferns et al., 2000). For example, losses varied from 31% of *Scoloplos armiger* to 83% of *Pygospio elegans* in dense populations. In muddy sand the abundance of *Cerastoderma edule* was reduced by ca 34%. Populations of *Nephtys hombergii*

Light abrasion at the surface only	and *Scoloplos armiger* took over 5 0 days to recover. Ho wever, reco very was more rapid in clean sa nd than in muddy sand. In mudd y sand, *Bathyporeia pilosa* took 111 days to recover wh ile *Cerastoderma edule*, *Pygospio elegans* and *Hydrobia ulvae* had not recovered their orig inal abundance after 174 days (Ferns et al., 2000). In a similar st udy, Hall & Harding (1997) found that non-target benthic fauna recovered within 56 days after mechanized cockle harvesting. However, Hall & Harding (1997) st udy took place in sum mer while Ferns et al. (2000) study occurred in winter. Despite the ir apparent robust body form, bivalves are also vulnerable to physical abrasion. For example, as a result of tractor dredging activity, mortality and shell damage has been reported in *Mya arenaria* and *Cerastoderma edule* (Cotter et al., 1997). Epibenthic species such as amphipods and isop ods may be mobile and small enough to avoid damage. The tops of burrows may be dama ged and repaired subse quently at energetic cost to their inhabitants. Therefore, physical dist urbance at the benchmark level is likely to result in mortality or removal of a proportion of the in vertebrate macrofauna and an into lerance of intermediate has been r ecorded. The above evidence su ggests that recovery is possible wit hin a year, depending on the season in which the disturbance occurs. However, recruitment in *Cerastoderma edule* is sporadic and recovery, especially in LMS. Pcer could be more protracted. Therefore, a recoverability of high has been suggested.
Siltation rate changes	Smothering with 5 cm of sediment (that is, a rapid accumulation of sediment) for a month is unlike ly to adversely affect species tha t can burrow through sediment, although it may clog the feeding apparatus of suspension feeding organisms. Kranz (197 2, cited in Maurer, 1981) reporte d that tube dwelling pelecypods, that use m ucous to tra p food particles, and la bial deposit feeders were most intolerant of burial, whereas epibe nthic suspe nsion feede rs and boring species could no t tolerate a n addition o f more than 1 cm of se diment. Infaunal non-siphonate suspension feeders escaped 5 cm but were intolerant of less than 10 cm, whereas deep burrowing siphonate species could tolerate up to 50 cm. Mortalities were higher when the smoth ering sediment was atypical of that area, which would dramatically change the nature of the substrat um and hence the communities present, although no mention was made of the type of sediment in volved. Ove rall, it is po ssible t hat some species may be killed by smothering at the benchmark level and, th erefore, intolerance h as been assessed as intermediate. On ret urn to prior conditions, recovery of the intolerant species would most probably be high (see additional information).
	Changes in siltation rat e (resulting from chan ges in the hydrographic regime, runoff from the land or coastal construction) are likely to result in chang es in the sediment composition, certainly of the surface layers and hen ce the communities present. Increased siltation may increase the proportion of mud or silt in the surface lay ers. Althou gh an incr ease in in organic particles may interfere with the feeding apparatus of suspension feeders, and potentially result in a decreased total ing estion over the benchmark period, the majority of fauna would be unaffected and an intolera nce of low has been recorded. Recovery i s expected to be very high.

	Changes in siltation rate (resulting from changes in the hydrographic regime, runoff from the land or coastal construction) are likely to result in changes in the sediment composition, certainly of the surface layers and hence the communities present. Decreased siltation may be associated with overall erosion of intertidal flats (where erosion is not compensated by deposition) although this is unlikely to have a huge effect over the benchmark period. An intolerance of low has been suggested to reflect the likelihood that the sediment dynamics will change. However, recovery is expected to be very high on return to normal conditions.
Introduction or spread of non-indigenous species.	Microbial pathogens are generally species specific and not relevant in a discussion of a biotope complex.
Removal of target habitat	Introduction of North American cord grass *Spartina alterniflora* to stabilize and reclaim high intertidal mudflats has significantly altered UK saltmarsh. *Spartina alterniflora* hybridized with native *Spartina marina* producing an infertile hybrid (*Spartina townsendii*) which gave rise to fertile *Spartina anglica*. *Spartina anglica* is fast growing and aggressive and has colonized extensive areas of intertidal mudflats, increasing the area of saltmarsh in the UK but reducing intertidal feeding grounds for shorebirds. *Merceneria mercenaria* was successfully introduced from the USA into Southampton Water in 1925. It is found buried in muddy sediment on the lower shore and shallow sublittoral and in bays and estuaries. In Southampton, it filled the niche left by *Mya arenicola* following a severe winter die-off and has prevented the re-establishment of the Mya population (Eno et al., 1997). Furthermore, digging and dredging for Mercenaria has had adverse effects on the environment, especially Zostera beds (Cox, 1991; Anon, 1992, both cited in Eno et al., 1997). It is likely that some species will experience a reduction in abundance and intolerance has, therefore, been assessed as intermediate. Recovery is likely to be low since an established saltmarsh will lead to a long-term decrease in the extent of the LMS.MS biotope and, in some areas, this may be permanent.
Removal of non-target habitat	In general, extraction of fish or shellfish can have the following community effects: extraction of juvenile fish and loss of the biotopes nursery function; displacement of non-target species; reduction in community diversity and species richness, e.g. from bait digging (Brown & Wilson, 1997); increased numbers of scavengers and organic enrichment due to discards (Elliot et al., 1998). Removal of *Cerastoderma edule* (cockles) by targeted fishery may result in an altered community and reduced extent of the LMS.Pcer biotope. In some circumstances, where the superficial sediment is shallow, bait digging can also change surface granulometry (M. Kendall, pers. comm.). In the intertidal, mechanical cockle harvesting resulted in significant losses of common invertebrates in muddy sand and clean sand in the Burry Inlet (Ferns et al., 2000). For example, losses varied from 31% of *Scoloplos armiger* to 83% of *Pygospio elegans* in dense populations. In muddy sand the abundance of *Cerastoderma edule* was reduced by ca 34%. As a result of tractor dredging activity, mortality and shell damage has also been reported in *Mya arenaria* and *Cerastoderma edule* (Cotter et al., 1997). Therefore, targeted extraction of cockles is likely to result in mortality or removal of a proportion of the invertebrate macrofauna and an intolerance of intermediate has been recorded. Ferns et al., 2000 reported that populations of *Nephtys hombergii* and *Scoloplos*

	armiger took over 50 days to recover. However, recovery was more rapid in clean sand than in muddy sand. In muddy sand, *Bathyporeia pilosa* took 111 days to recover while *Cerastoderma edule*, *Pygospio elegans* and *Hydrobia ulvae* had not recovered their original abundance after 174 days (Ferns et al., 2000). In a similar study, Hall & Harding (1997) found that non-target benthic fauna recovered within 56 days after mechanized cockle harvesting. However, Hall & Harding (1997) study took place in summer while Ferns et al. (2000) study occurred in winter. The above evidence suggests that recovery is possible within a year, depending on the season in which the disturbance occurs. However, recruitment in *Cerastoderma edule* is sporadic and recovery, especially in LMS.Pcer could be more protracted. Therefore, a recoverability of high has been suggested.

2.11	**Intertidal Mudflat LGS.Lan**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The distribution of polychaete and bivalve species characteristic of the biotope extend to the south of the British Isles, so are likely to be tolerant of a long-term chronic temperature increase of 2° C , e.g. *Cerastoderma edule* (Wilson, 1993). In the intertidal, acute temperature increases at the surface can be avoided to some extent by burrowing, however, in very hot weather mortalities can occur, but it is rarely clear whether such mortalities are a direct result of high temperatures or an indirect consequence of oxygen deficiency resulting from increased bacterial activity and oxygen consumption. Lethal temperatures (LT₅₀) have been reported for some species, e.g. Ansell et al. (1981) reported an upper median lethal temperature of 35°C after 24 hrs (29°C after 96 hrs), whilst Wilson (1981) reported an upper LT_{50} of 42.5°C for *Cerastoderma edule*. However, temperatures in excess of 20°C within the substratum are likely to be uncommon in the British Isles. An intolerance assessment of intermediate has been made as some individuals may die as a consequence of acute increases in temperature. Recoverability has been assessed to be high (see additional information below).
Temperature changes - local decrease	Although recorded to the north of the British Isles, the dominant and key structural polychaete *Lanice conchilega* is intolerant of acute decreases in temperature (Beukema, 1990). An intertidal population of *Lanice conchilega*, in the northern Wadden Sea, was wiped out during the severe ice winter of 1995/96 (Strasser & Pielouth, 2001), and Crisp (1964) described mortality of *Lanice conchilega* between the tidemarks but not at lower levels during the severe winter of 1962/63. Other characterizing species in the biotope are recorded to the north of the British Isles and therefore are likely to be tolerant of a long-term chronic decrease in temperature, but also may be vulnerable to acute temperature decreases. For example, high mortalities of cockle populations attributed to severe winters have been reported by many authors (Kristensen, 1958; Hancock & Urquhart, 1964; Beukema, 1990; Ducrotoy et al., 1991) and high shore populations are likely to be more vulnerable to extremes of temperature owing to their longer emergence time. Other infaunal species may

	be protected to some extent by the ability to burrow deeper within the sediment. Intolerance has been assessed to be high as evidence suggests that intertidal populations of *Lanice conchilega* and *Cerastoderma edule* are vulnerable to acute decreases in temperature. Recoverability has been assessed to be high. Following the severe winter in the Dutch Wadden Sea, a population of *Lanice conchilega* took three years to fully recover, as there was low recruitment for the first two years (Strasser & Pielouth, 2001). *Cerastoderma edule* may recover within a year, however, given the sporadic nature of recruitment in the species, recovery may be more protracted and take several years.
Salinity changes - local increase	LGS.Lan occurs in locations of full to variable salinity (Connor et al., 1997a). No information was found concerning the intolerance of the community to hypersaline conditions.
Water flow (tidal current) changes - local increase	The nature of the substratum is, in part, determined by the hydrodynamic regime including water flow rate. Changes in the water flow rate will change the sediment structure and have concomitant effects on the community, as many sediment dwelling species have defined substratum preferences (e.g. amphipods such as *Bathyporeia pelagica*). Moderate to high velocities of water flow have been reported to enhance settlement of *Lanice conchilega* larvae (Harvey & Bourget, 1995), but the benchmark increase in water flow from moderately strong to very strong, would probably winnow away smaller particulates, increasing average particle size in favour of gravels and pebbles. Therefore, the density of the *Lanice conchilega* population would decline, in part due to lack of suitable substrata with which to build its tubes, and partly from interference with its feeding. In the absence of *Lanice conchilega* the biotope would not be recognized and intolerance has been assessed to be high. The community would probably become dominated by water flow tolerant species with a preference for/ or tolerant of a coarser more mobile substratum, e.g. crustaceans (burrowing haustoriid and oedecerotid amphipods) and errant polychaetes (Elliott et al., 1998). Intolerance has been assessed to be high as the dense Lanice biotope would not be recognized. On return to prior conditions recovery of the *Lanice conchilega* dominated community is probable, although recovery may take several years as recolonization would be dependent on larval recruitment, which is more successful in the presence of conspecific adults.
Water flow (tidal current) changes - local decrease	The nature of the substratum is, in part, determined by the hydrodynamic regime including water flow rate. Changes in the water flow rate will change the sediment structure and have concomitant effects on the community. Reduced water flow is a factor that has been identified as affecting the density of *Lanice conchilega*. Recruitment to the benthos is reduced under low flow as a result of reduced turbulence (Harvey & Bourget, 1995). Furthermore, at the benchmark level, decreased water flow rate would probably increase deposition of finer sediments, and increase siltation. The sediment would probably begin to favour deposit feeders and detritivores, to the detriment of the suspension feeders. The average grain size of the sediment would be reduced, and the community may start to be replaced over a period of one year by communities more characteristic of muddy sands, e.g. predominantly sessile tube-dwelling polychaetes and bivalves that primarily deposit feed, e.g. *Macoma balthica*. Intolerance has been assessed to be high as the *Lanice conchilega* biotope would not be recognized. Recovery is likely on return to prior conditions, but a transitional community may persist for several years.

Emergence regime changes - local increase	The majority of the species in the biotope, including the important characterizing species, live infaunally and are therefore protected from the short term stresses of an increase in emergence regime. However, over time the increased emergence would be likely to result in an energetic cost due to reduced feeding opportunities. Many of the species, e.g. mobile polychaetes and amphipods, would be able to relocate to their preferred position on the shore. *Lanice conchilega* is not a mobile species and mortalities might be expected as a result of increased predation by birds, increased exposure to desiccation and changes in temperature. Over a period of one year a decrease in the density of *Lanice conchilega* may occur and intolerance has been assessed to be intermediate. The biotope would probably still be recognizable but would be impoverished.
Emergence regime changes - local decrease	*Lanice conchilega* also thrives in the shallow subtidal zone (See IGS.Lcon - Dense *Lanice conchilega* and other polychaetes in tide swept infralittoral sand) therefore would not be intolerant of a decreased emergence regime. It is possible that decreased emergence would allow *Lanice conchilega* and other species in the biotope to colonize further up the shore. Hence, not sensitive* has been recorded.
Wave exposure changes - local increase	The predominant factor controlling the intertidal community is wave exposure (Eleftheriou & McIntyre, 1976), and a sedentary fauna of sedentary tube dwelling polychaetes, such as *Lanice conchilega*, and long-lived bivalves dominate in sheltered areas (Elliott et al., 1998). Such communities are likely to be severely affected by increased wave exposure for the period of one year and a large reduction in species richness and abundance is likely, owing to wash-out, disrupted feeding and burrowing activity in addition to inhibited recruitment by larvae. A transitional community of opportunistic species is likely to result, consisting of agile haustoriid (Bathyporeia spp.) and oedecerotid (Pontocrates spp.) amphipods and errant polychaetes in which diversity increases towards the low shore area (Eleftheriou & McIntyre, 1976). The biotope would change to another, e.g. LGS.AP (Burrowing amphipods and polychaetes in clean sand shores) and thus intolerance has been assessed to be high. Recoverability of the *Lanice conchilega* community would be determined by the degree of change. Over a period of one year, a change in shore topography (gradient and shore width) and grain size is likely following intense wave action, with concomitant changes in the physical and biological integrity of the habitat, perhaps leading to a persisting change in community composition despite a return to prior conditions. However, a succession in the type of species that dominate the habitat is likely as species that were lost as a result of increased exposure gradually return. A recoverability of moderate has been suggested.
Wave exposure changes - local decrease	The biotope occurs in 'moderately' to 'very sheltered' locations (Connor et al., 1997a). A further decrease in wave exposure may result in increased siltation and a consequent change in sediment characteristics (Hiscock, 1983). A substratum with a higher proportion of fine sediment would probably result in the increased abundance of the deposit feeders within the biotope, particularly species which favour finer sediments, such as the polychaete *Aphelochaeta marioni* and the echinoid *Echinocardium cordatum*. However, in the absence of wave action, tidal flow is likely to be a more significant factor structuring the community, replenishing oxygen, supplying planktonic recruits and would maintain a supply of suspended organic matter in suspension for suspension feeders. Therefore the biotope has been assessed not to be sensitive.

Water clarity increase	It is possible that decreased turbidity would increase primary production in the water column by phytoplankton and by the microphytobenthos of the interstices of the sand. Increased food availability may enhance growth and reproduction of both suspension and deposit feeding species but only if food was previously limiting. An intolerance assessment of not sensitive* has been made.
Water clarity decrease	Production within the biotope is predominantly secondary, derived from detritus and to some extent phytoplanktonic production. Characteristic infauna do not require light and therefore the effects of increased turbidity on light attenuation are not directly relevant. However an increase in turbidity may affect primary production by phytoplankton and the microphytobenthos thereby affecting food supply. However as organic material would be transported in to the biotope from other areas on the flood tide the effect of increased turbidity may be mitigated to some extent. At the benchmark level increased turbidity persists for a year, so reduced food availability may affect the condition of species and an intolerance of low has been recorded. As soon as light levels return to normal, phytoplanktonic and microphytobenthic primary production would increase, the species would resume optimal feeding, so recoverability has been assessed to be very high.
Habitat structure changes - removal of substratum (extraction)	Characterizing species within this biotope are infaunal and would therefore be removed along with the substratum. Intolerance has been assessed to be high because the species which characterize the biotope would be lost. Recoverability has been assessed to be high. See additional information below.
Heavy abrasion, primarily at the seabed surface	*Lanice conchilega* inhabits a permanent tube and is likely to be damaged by any object that penetrates or drags through the sediment, as are all other infaunal polychaetes. Ferns et al. (2000) recorded significant losses of common infaunal polychaetes from areas of muddy sand worked with a tractor-towed cockle harvester. For instance, 31% of the polychaete *Scoloplos armiger* (initial density of 120 per m^2) and 83% of *Pygospio elegans* (initial density 1850 per m^2) were removed. The population of *Pygospio elegans* remained depleted for more than 100 days after harvesting, whilst those of *Nephtys hombergii*, *Scoloplos armiger* and Bathyporeia spp. were depleted for over 50 days. The tubes of *Lanice conchilega* were damaged but this damage was seen to be repaired. In locations of cleaner sand with lower densities of *Cerastoderma edule* and dense aggregations of *Lanice conchilega*, recovery occurred more rapidly. Cockles are often damaged during mechanical harvesting, e.g. 5-15% were damaged by tractor dredging (Cotter et al, 1997) and ca 20% were too damaged to be processed after hydraulic dredging (Pickett, 1973). Therefore, an overall biotope intolerance of intermediate has been recorded. Abrasion due to mooring, or anchoring is likely to result in less damage to the population. Recoverability has been assessed to be high (see additional information below).
Light abrasion at the surface only	
Siltation rate changes	Although all of the species in the biotope are able to move within the substratum to some extent, some species live at specific depths and/or have to maintain contact with the surface. For instance, Ziegelmeier (1952) showed that *Lanice conchilega* increased the height of its tube top with increasing sedimentation so that it could continue feeding and respire. The bivalve *Cerastoderma edule* has short siphons and needs to keep in contact with the surface of the sediment. It will quickly burrow to the surface if covered by as little as 2 cm of sediment (Richardson et al., 1993b) but Jackson & James (1979) reported that cockles buried under 10 cm of sediment were unable to burrow back to the surface and

	over a period of six days 83% mortality was recorded. In the same experiment, most cockles buried to a depth of 5 cm were able to regain contact with the surface. In muddy substrata all cockles died between three and six days. Nephtys species are highly mobile within the sediment. Vader (1964) observed that *Nephtys hombergii* relocated throughout the tidal cycle and is unlikely to be affected by smothering with a sediment consistent with that of the habitat. Intolerance has been assessed to be intermediate as mortality of some cockles (especially smaller individuals) and probably other species may occur. At the benchmark level the composition of the community would probably not alter to the extent that the biotope would not be recognised. In years of good cockle recruitment recovery of the population may occur within a year, however, recruitment tends to be sporadic (see *Cerastoderma edule*, reproduction) and may take longer in 'bad' years.
	Suspension feeding species within the biotope may benefit from an increase in suspended sediment, e.g. *Lanice conchilega* and *Cerastoderma edule*, especially if the suspended material includes a significant proportion of organic matter and food was previously limiting. *Lanice conchilega* uses its 'feeding crown' of tentacles to capture particles and unless the 'feeding crown' becomes clogged and requires excessive cleaning at energetic cost the species is unlikely to be especially affected. Navarro & Widdows (1997) considered that *Cerastoderma edule* was well adapted to living in environments with high concentrations of suspended sediment. The cockles compensate by increased pseudofaeces production but with concomitant loss of energy and carbon as mucus. The intolerance of the community has been assessed to be low as species may suffer loss of condition over the period of one month as a consequence of excessive clearance.
	A decrease in suspended sediment would reduce the amount of food available for suspension feeders such as *Lanice conchilega* and *Cerastoderma edule*. Deposit feeding polychaetes such as *Arenicola marina* are unlikely to be significantly affected, as over a period of one month deposits of organic matter are unlikely to become limiting as a consequence of reduced supply. Navarro & Widdows (1997) suggested that *Cerastoderma edule* was able to compensate for a decrease in particulate quality (i.e. proportion of organic to inorganic seston) between 1.6 to 300 mg/l, accomplished by excessive preingestive selection of organic particles, together with increasing filtration and rejection rates. Over a period of one month loss of condition may occur but mortality is considered to be unlikely and intolerance has been assessed to be low. On return to prior conditions optimal feeding is likely to resume and recoverability has been assessed to be very high.

Introduction or spread of non-indigenous species.	Insufficient information was found concerning microbial pathogens and parasites of polychaete species. However, more than 20 viruses have been described for marine bivalves (Sinderman, 1990). Bacterial diseases are more significant in the larval stages and protozoans are the most common cause of epizootic outbreaks that may result in mass mortalities of bivalve populations. Parasitic worms, trematodes, cestodes and nematodes can reduce growth and fecundity within bivalves and may in some instances cause death (Dame, 1996). *Cerastoderma edule* may be infected by numerous larval digenean trematodes, and the parasitic copepod *Paranthessius rostatus* but no evidence of mass mortalities of cockles in the British Isles attributable to parasites was found. Boyden (1972) reported castration by parasites of a population of cockles from the River Couch. Parasitic infection is likely to directly or indirectly result in a reduced condition or abundance of affected populations, so intolerance has been assessed to be low.
Introduction of microbial pathogens	Relatively coarse sands, such as those of the LGS.Lan biotope, tend to have a relatively high oxygen concentration and a deep reducing layer. Brafield (1964) concluded that the most significant factor influencing oxygenation is the drainage of the beach which, in turn, is determined by the slope and particle size. Oxygen depletion becomes a severe problem at all states of the tide on only the finest grained beaches. Dense aggregations of *Lanice conchilega* serve to increase the oxygenation of the sediment. The species periodically withdraws from the surface into the sediment for a few seconds and in doing so exchanges the tube water with overlying water (Forster & Graf, 1995). So in normal circumstances oxygen is unlikely to become limiting. However, as a consequence of organic enrichment, oxygen concentration in the sediment may become depleted. Over a longer period concomitant changes in the infauna would occur and tend to show a consistent sequence of response, such as that of the Pearson-Rosenberg model (Pearson & Rosenberg, 1978), and the biotope would change. However, at the benchmark level assessment is made over the period of one week. Some important characterizing species seem tolerant of hypoxia whilst others are less so. For example, *Nephtys hombergii* was found to be particularly tolerant of severe hypoxia and hydrogen sulphide (Alheit, 1978; Arndt & Schiedek, 1997). Rosenberg et al. (1991) observed that *Cerastoderma edule* migrated to the sediment surface in response to reduced oxygen concentrations and reported 100% mortality of *Cerastoderma edule* exposed to 0.5-1.0 ml/l oxygen for 43 days. Theede et al. (1969) reported 50% mortality after 4.25 days at 1.5 ml/l oxygen. Theede et al. (1969) also noted that *Cerastoderma edule* only survived 4 days exposure of <6.1 cm^2/l of hydrogen sulphide, which is associated with anoxic conditions. *Cerastoderma edule* may therefore survive several days of anoxia but fatalities may occur over the duration of a week.intolerance has been assessed to be intermediate as some populations of species may be adversely affected. Recoverability has been suggested to be high (see additional information below).
Removal of target habitat	No evidence was found to suggest that important characterizing species of the biotope are threatened by alien species.

Removal of non-target habitat	The common cockle, *Cerastoderma edule* and the polychaetes Nephtys are characterizing species targeted for extraction within the biotope. Nephtys species are used by anglers as bait and the biotope may be subjected to bait digging. Jackson & James (1979) observed that bait digging disturbs sediment to a depth of 30-40 cm and probably buries many cockles below 10 cm, so that they are smothered (see smothering). *Cerastoderma edule* of marketable size can be harvested in both the intertidal and subtidal more rapidly and efficiently using mechanical methods, such as tractor-powered harvesters and hydraulic suction dredgers than by traditional methods. Hydraulic suction dredgers operate by fluidising the sand using water jets and then lifting the sediment and infauna into a revolving drum for sorting. The tractor-towed dredge utilises a blade between 70 -100 cm wide that penetrates to a depth of between 20-40 cm. Sediment is sorted through a rotating drum cage (Hall & Harding, 1997). Such machinery adversely impacts on non-target infaunal species as they are sucked or displaced from the sediment and sustain damage as 'by-catch' (see abrasion & physical disturbance). Cotter et al. (1997) noted that tractor dredging reduced the *Cerastoderma edule* stock by 31-49% depending on initial density, while Pickett (1973) reported that hydraulic dredging removed about one third of the cockle fishery. Franklin & Pickett (1978) noted that subsequent spat survival was markedly reduced and Pickett (1973) noted reduced survivability of 1-2 year old cockles after hydraulic dredging. Furthermore, tractor dredging leaves visible tracks in the sediment, which can act as lines for erosion accelerating erosion of the sediment (Moore, 1991; Gubbay & Knapman, 1999). However, most studies concluded that the impact of mechanised dredging on cockle populations and other macrofauna in the long term was low (Pickett, 1973; Franklin & Pickett, 1978; Cook, 1990; Moore, 1991; Cotter et al., 1997; Hall & Harding, 1997; Ferns et al., 2000). Time of year of exploitation will influence recovery and avoiding seasonal spawning or larval settlement periods is likely to reduce the time taken for recovery (Gubbay & Knapman, 1999). Cockle beds have been subjected to mechanical fishing for decades but several beds are closed form time to time depending on settlement and recruitment to the population, which is sporadic. Recovery may take less than a year in years of good recruitment but would take longer in years of poor recruitment. A recoverability of high has been suggested.

2.12	**Intertidal underboulder communities MLR.Fser.Bo**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The shaded and damp conditions found in underboulder communities may serve to protect the MLR.Fser.Fser.Bo community from extremes of temperature. Nevertheless, the important species found in this biotope have varying levels of tolerance to changes in temperature at the benchmark level and some species living under boulders are normally subtidal species and may be unable to withstand large changes in temperature. *Pisidia longicornis* occurs in a wide range of temperature regimes from Norway to Angola and it is unlikely that they would be adversely affected by an increase in temperature at the level of the benchmark. The British Isles are at the centre of geographical range for *Umbonula littoralis*, *Botryllus schlosseri* and *Halichondria panicea* suggesting that colonies are likely to be tolerant of both an increase and decrease in temperature at the benchmark level. *Balanus crenatus* is a boreal species that is likely to be intolerant of increases in water temperature. In Queens Dock, Swansea, where the water temperature was on average 10°C higher than average due to the effects of a condenser effluent, *Balanus crenatus* was replaced by the subtropical barnacle *Balanus amphitrite*. After the water temperature cooled *Balanus crenatus* returned (Naylor, 1965). *Balanus crenatus* was unaffected during the severe winter of 1962-63, when average temperatures were 5 to 6 °C below normal (Crisp, 1964a). Gamete release in *Dendrodoa grossularia* decreases at 15 degrees and is suppressed at 20 degrees and below about 8-11 degrees (Millar, 1954). It is likely to be sensitive to an increase and decrease in temperature at the benchmark level. On balance, it is likely that overall intolerance to an increase in temperature will be low.
Temperature changes - local decrease	The shaded and damp conditions found in underboulder communities may serve to protect the MLR.Fser.Fser.Bo community from extremes of temperature. Nevertheless, the important species found in this biotope have varying levels of tolerance to changes in temperature at the benchmark level and some species living under boulders are normally subtidal species and may be unable to withstand large changes in temperature. *Pisidia longicornis* were adversely affected by the 1962-63 winter in Britain. Crisp (1964a) records that many hundreds were found dead on the strandline at Oxwich, south Wales. In other locations, they were not found on the shore (although could have migrated offshore). The British Isles are at the centre of geographical range for *Umbonula littoralis*, *Botryllus schlosseri* and *Halichondria panicea* suggesting that colonies are likely to be tolerant of both an increase and decrease in temperature at the benchmark level. Gamete release in *Dendrodoa grossularia* decreases at 15 degrees and is suppressed at 20 degrees and below about 8-11 degrees (Millar, 1954). It is likely to be sensitive to an increase and decrease in temperature at the benchmark level. On balance, it is likely that overall intolerance to a decrease in temperature will be low.
Salinity changes - local increase	Underboulder communities occur in full to variable salinity habitats although it might be that higher salinity occurs at the outflow of some basins. At the levels expected, MLR.Fser.Fser.Bo is likely to be tolerant to an increase in salinity.

Water flow (tidal current) changes - local increase	The richest underboulder communities develop in areas subject to strong tidal flows and, therefore, at the benchmark level, MLR.Fser.Fser.Bo is likely to be tolerant*.
Water flow (tidal current) changes - local decrease	A decrease in strength of tidal flow will lead to loss or reduction in abundance of some species and this would most likely be a result of increased siltation. Species including *Pisidia longicornis* and *Umbonula littoralis* thrive in habitats that are in areas of moderate to strong water movement. A decrease in water flow rates where wave action is also weak would be likely to result in mortality in, for example, some bryozoans, colonial ascidians and sponges. This is most likely as a secondary effect from siltation but possibly also due to a reduction in food source. Barnes & Bagenal (1951) found that the growth rate of *Balanus crenatus* epizoic on *Nephrops norvegicus* was considerably slower than animals on raft exposed panels and this was attributed to reduced currents and increased silt loading of water in the immediate vicinity of *Nephrops norvegicus*. Intolerance is, therefore, assessed as intermediate. However, recoverability will be high (see additional information).
Emergence regime changes - local increase	A one hour change in the time not covered by the sea for a period of one year is unlikely to adversely affect the majority of the MLR.Fser.Fser.Bo community since the habitat is likely to remain shaded and damp. Mobile species such as *Pisidia longicornis* and *Carcinas maenas*, because of their mobility, may be able to escape the effects of increased emergence by crawling to damper areas further down the shore. On balance, however, MLR.Fser.Fser.Bo has been assessed as being of intermediate intolerance to changes in emergence to reflect the likelihood that species at the limits of their tolerance to emergence might be killed. Recoverability is likely to be high (see additional information).
Emergence regime changes - local decrease	A decrease in emergence would reduce the influence of desiccation on the community which would be beneficial to the biotope. However, this benefit may be counteracted by the fact that the more submerged boulders may be subject to increased disturbance through wave energy. Larger boulders previously undisturbed may move around more, potentially leading to an increased species diversity (see Ecology). On balance, MLR.Fser.Fser.Bo has been assessed as tolerant to a decrease in emergence.
Wave exposure changes - local increase	Many of the species likely to be found in MLR.Fser.Fser.Bo communities are probably tolerant of very wave exposed conditions. However, increases in wave exposure may cause more boulders to become mobile and abrade underboulder communities. Increased mobilization of boulders may result in patches of sponges, bryozoans and barnacles being crushed on impact with other boulders. For example, *Umbonula littoralis* has a hard calcareous skeleton which is likely to be broken through contact with hard surfaces such as cobbles moving around during storms. Crabs and other fragile mobile species are also at risk from being crushed. Furthermore, many of the stable boulders are fused together by algal growth (especially corallines) and breaking up this matrix would adversely affect the community (Foster-Smith, pers. comm.). The release of sediment between boulders may serve to interrupt suspension feeding (see Suspended Sediment above). MLR.Fser.Fser.Bo is found on shores ranging from wave sheltered to moderately wave exposed and as a result the communities in the biotope between each of these locations will vary anyway and. Therefore, different

	sites are likely to have varying tolerances with respect to changes in wave exposure. On balance, MLR.Fser.Fser.Bo has been assessed as being of intermediate intolerance to a change in wave exposure since some species may experience mortality although even frequently disturbed boulders with a few pioneer species may still represent MLR.Fser.Fser.Bo. Recovery is expected to be rapid (see additional information).
Wave exposure changes - local decrease	A decrease in wave exposure may facilitate sedimentation which will smother underboulder species resulting in mortality (see Smothering above). MLR.Fser.Fser.Bo is found on shores ranging from wave sheltered to moderately wave exposed and as a result the communities in the biotope between each of these locations will vary anyway and. Therefore, different sites are likely to have varying tolerances with respect to changes in wave exposure. On balance, MLR.Fser.Fser.Bo has been assessed as being of intermediate intolerance to a change in wave exposure since some species may experience mortality although even frequently disturbed boulders with a few pioneer species may still represent MLR.Fser.Fser.Bo. Recovery is expected to be rapid (see additional information).
Water clarity increase	A decrease in turbidity may stimulate phytoplankton production which would be beneficial to the suspension feeding community associated with MLR.Fser.Fser.Bo. Therefore, it has been suggested that MLR.Fser.Fser. Bo is tolerant to an increase in turbidity at the benchmark level.
Water clarity decrease	Rich underboulder communities are known to occur in turbid waters, for instance, the Menai Strait. Therefore, it has been suggested that MLR.Fser.Fser.Bo is tolerant to an increase in turbidity at the benchmark level.
Habitat structure changes - removal of substratum (extraction)	Substratum removal will result in the loss of the entire MLR.Fser.Fser.Bo community and, therefore, intolerance has been assessed as high. Although mobile species including the long - and broad-clawed porcelain crabs may survive, they are not, in isolation, representative of MLR.Fser.Fser.Bo. Recoverability is likely to be high (see additional information).
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	In addition to disturbance caused by wave energy, intertidal boulder communities are often disturbed by, for example, bait collectors, inquisitive school groups and field researchers. Boulders left overturned place the organisms on the now upward facing part of the boulder at great risk of desiccation (see Desiccation above). Furthermore, many stable boulders are fused together by algal growth (especially corallines) and breaking this matrix would be very harmful (Foster-Smith, pers. comm.). Furthermore, this disturbance and habitat degradation could change a stable boulder field to an unstable field on a long-term basis (Foster-Smith, pers. comm.). Movement of the boulder surface against other hard surfaces (for instance, during extreme storm events) is likely to cause significant damage to encrusting fauna that is characteristic of the community. Recoverability is expected to be high (see additional information).

Siltation rate changes	Many of the underboulder species are low-lying encrusting forms that cannot escape smothering and are, therefore, especially vulnerable. Over the course of one month, feeding in suspension feeders is likely to be inhibited as a result of the clogging of the feeding apparatus. In addition, deoxygenation will occur due to the decomposition of smothered matter under the boulder. *Balanus crenatus* can withstand covering by silt provided that the cirri can extend above the silt layer but smothering by 5 cm of sediment would prevent feeding and could cause death. It is likely that many of the important species including the bryozoans and colonial ascidians will experience mortality and accordingly, intolerance has been assessed as high. However, smothering by sand is part of the natural dynamics of some boulders (Foster-Smith, pers. comm.) and the fact that the majority of underboulder communities are downward facing means that the effects of smothering are likely to be relatively short lived. Recoverability is expected to be high (see additional information). (This assessment is for smothering by sediment - some typical underboulder species can survive overgrowth by other species (c.f. Turner, 1988)).
	Underboulder communities face downwards so that silt is unlikely to settle but may clog the feeding structures of some species such as hydroids, bryozoans and ascidians thereby reducing total ingestion over the benchmark period. *Umbonula littoralis* for example, is expected to have a limited ability to clear itself of silt. Rich underboulder communities are known to occur in turbid waters, for instance, the Menai Strait. However, increased suspended sediment, in combination with areas of low wave energy or water movement may lead to siltation (see water flow rate) and therefore, intolerance has been assessed as intermediate. Recoverability is likely to be high (see additional information).
	A decrease in suspended sediment is likely to be beneficial to most of the underboulder community. The suspension feeders may become more efficient as there would be fewer inorganic particles to clog and interfere with feeding apparatus. Assuming that the decrease in suspended sediment refers to inorganic particles, a reduction in total ingestion in the suspension feeding community is not expected. Therefore, tolerant* has been assessed.
Introduction or spread of non-indigenous species.	Insufficient information.
Introduction of microbial pathogens	Underboulder habitats may be subject to lowered oxygen levels due to restricted water flow in calm periods. Also, organic debris that becomes trapped under the boulders may rot and cause de-oxygenated conditions. Some tolerance of low oxygen levels is therefore expected in some situations. However, the richest underboulder communities occur where water flow is strong and almost continuous and might suffer in de-oxygenated conditions. Component species generally have planktonic larvae and reproduce frequently so that re-colonization will be rapid.
Removal of target habitat	Insufficient information.

Removal of non-target habitat	Species that are extracted from underboulder communities include edible crustaceans which, as scavengers, are not of key importance in the functioning of the community. None of the important species are likely to be targeted for extraction although the collection of other creatures including crabs and shrimps may result in increased physical disturbance, to the detriment of the community (see Physical Disturbance).

2.13	Kelp and seaweed communities on sublittoral sediment IMX.FiG
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The sort of location in which this biotope occurs may be subject to significant increased temperatures as a result of its isolation. Increased temperature may stimulate increased bacterial activity, increased oxygen consumption and therefore depletion of oxygen from the interstitial waters resulting in reduced oxygen levels (hypoxia) or absence of oxygen (anoxia) (see deoxygenation) in the sediment (Hayward, 1994). The lack of water circulation resulting from isolation of the habitat will be exacerbated especially in summer by the blanket of filamentous seaweed reducing water flow. Since hypoxia already occurs, increased temperature might significantly increase de- oxygenation at the seabed especially where blanketed by algae and mortality of at least some benthic species. An intolerance of intermediate has therefore been indicated. Regrowth should be rapid from remaining species and many mobile species would return rapidly.
Temperature changes - local decrease	The sort of location in which this biotope occurs may be subject to significant decreased temperatures as a result of its isolation. However, in winter, the characterizing algae species will be in low abundance and species such as mysids and *Gasterosteus aculeatus* can migrate to deeper waters. Decreased temperature is, however, likely to result in mortalities amongst some characterizing species. For instance, in *Akera bullata* in the Fleet, high mortality coincided with cold winds with low water and rain although it recolonized from deeper populations (Thompson & Seaward, 1989). During the cold winter of 1962-63, *Carcinus maenas* adults were found moribund or dead all around the coast of Britain but smaller individuals were less affected and dominated the surviving population in March-April (Crisp, 1964). Some other benthic species may be highly tolerant. *Mytilus edulis*, where it occurs, can withstand extreme cold and freezing, surviving when its tissue temperature drops to -10°C (Williams, 1970; Seed & Suchanek, 1992). Therefore, some species might be expected to be lost or their population numbers decline as a result of decrease in temperature and an intolerance of intermediate is indicated. Since recoverability of intolerant species is likely to be by migration, recoverability is indicated as very high.
Salinity changes - local increase	The biotope occurs in reduced salinity conditions and some of the component species are only or mainly found in such conditions. For instance *Gasterosteus aculeatus* and mysid shrimps may thrive in low salinity conditions and may be lost if salinity changes in the long term (for instance from reduced to variable salinity for a year). *Carcinus maenas* is also found in low to variable salinity conditions but would most likely survive at the benchmark change level. The filamentous algae that dominate this biotope appear to thrive in low salinity conditions. Some of the species in the biotope have a wide tolerance to salinity. For instance, *Akera bullata* was found to occur in salinities from full to 6 psu in the Fleet (Thompson & Seaward, 1989) whilst Henry et al. (1999) suggests that *Carcinus maenas* can survive in salinities from 8 to 40 psu. Most importantly, it seems likely that species previously unable to colonize the biotope because of its low salinity may settle and grow changing the biotope to a different one perhaps dominated by ascidians and sponges (for instance

	SCR.SubSoAs). The biotope would therefore be lost and intolerance is high. For recoverability, see additional information below.
Water flow (tidal current) changes - local increase	This biotope occurs in very still conditions and increase in tidal flow rate is likely to adversely affect some species so that the biotope may change to a different one. In particular, algal mats may offer significant resistance to flowing water and, as they are poorly attached or not attached, be swept away together with associated species such as *Akera bullata*. Many of the animal species in the biotope occur in conditions of at least moderate flow. Some mobile species such as *Neomysis integer* (see Lawrie et al., 1999) avoid strong flow but occur in estuaries so that they would be expected to persist. Burrowing species would be protected providing that the sediment was not swept away. For instance, increases in water flow rate are unlikely to affect *Arenicola marina* directly since it lives in a deep burrow. *Mytilus edulis*, which is abundant in high tidal currents at the exits of variable salinity habitats, may increase in abundance or occur for the first time in the biotope if increase in water flow rates is long- term. Overall, some of the key characterizing species are likely to be lost and recruitment of species that are favoured by flowing water (for instance, brown seaweeds sponges, mussels, hydroids, bryozoans and barnacles) will occur possibly switching the biotope (perhaps, where sediment predominates, to IMX.LsacX - *Laminaria saccharina*, *Chorda filum* and filamentous red seaweeds on sheltered infralittoral sediment or IMX.MytV - *Mytilus edulis* beds on variable salinity infralittoral mixed sediment. Once conditions return to low tidal flow, demise of species thriving in strong flow will occur and re-growth or recolonization is likely to be rapid.
Water flow (tidal current) changes - local decrease	The biotope occurs in extremely shelter situations with no or little water flow so that this factor is considered not relevant.
Emergence regime changes - local increase	The biotope occurs in shallow waters and may be subject to drying out in increased emergence. Algae would be expected to dry and be bleached causing death although the mat of algae would protect species under it including algal filaments. Many animal species in the biotope are mobile and would escape. *Arenicola marina* is protected from desiccation because it lives in a deep, water filled burrow. *Mytilus edulis*, where present, can close its valves and survive for significant periods out of water. Because significant species in the biotope would be likely to be killed in the fringing parts of the biotope, intolerance is described as intermediate. Recovery is likely to be very high as re-growth of algae will occur and mobile animal species recolonize.
Emergence regime changes - local decrease	The biotope is subtidal and decrease in emergence is not relevant.

Wave exposure changes - local increase	Increased wave exposure may cause erosion of fine sediments decreasing the extent of the available habitat for some species. The larval nursery areas of *Arenicola marina* may be particularly intolerant since the larvae inhabit the top few centimetres of the substratum. Increased wave exposure may also dislodge mats of filamentous algae and species such as *Akera bullata* displacing them to unfavourable habitats. Some other species may not be affected. Adult *Arenicola marina* living below the sediment surface and anyway known from moderately exposed situations is likely to survive. Mobile species such as *Carcinus maenas* will find shelter or move to deeper water. Mysid shrimps are also likely to find shelter or to abandon the area. Increased wave exposure may improve oxygenation and prevent hypoxia. However, overall, since the filamentous algae are likely to be adversely affected the biotope may become difficult to recognise and switch to another more characteristic of wave exposed conditions and an intolerance of high is suggested.
Wave exposure changes - local decrease	The biotope occurs in ultra sheltered situations and so decrease in wave exposure is considered not relevant.
Water clarity increase	Decreased turbidity will improve light penetration and therefore algal growth and will improve the ability of hunting species (mysid shrimps and *Gasterosteus aculeatus*) to catch prey. Overall, it is expected that decreased turbidity will improve prospects for many species in the biotope.
Water clarity decrease	Increased turbidity will reduce light penetration with possibly adverse effects on growth of the dense mats of algae characteristic of this biotope. Benthic diatom productivity is also likely to be reduced possibly reducing this source of food for *Arenicola marina*. However, *Arenicola marina* also feeds on meiofauna, bacteria and organic particulates in the sediment is unlikely to be affected significantly. Similarly, *Akera bullata* switches to feeding on the muddy bottom when algal growth is sparse in winter (Thompson & Seaward, 1989) and may be adversely affected by lack of diatom production. The extent of the biotope with depth may be reduced and therefore an intolerance of intermediate is indicated. The algal species likely to be affected will colonize and grow very rapidly once turbidity declines and so a very high recoverability is indicated.
Nutrient enrichment	The development of algal growth in likely to be nutrient limited (see, for instance Pedersen & Borum, 1996). Increased nutrient levels may, therefore, increase algal growth including of phytoplankton to the benefit of suspension feeders such as *Mytilus edulis* and solitary ascidians. The abundance and biomass of *Arenicola marina* increases with increased organic content in their favoured sediment (Longbottom, 1970; Hayward, 1994). Therefore, moderate nutrient enrichment may be beneficial. However, increasing nutrient enrichment may result in a well studied succession from the typical sediment community, to a community dominated by opportunist species (e.g. capitellids) with increased abundance but reduced species richness and eventually to abiotic anoxic sediments (Pearson & Rosenberg, 1978). Indirect effects may include algal blooms and the growth of algal mats (e.g. of Ulva sp.) on the surface of the intertidal flats. Algal mats smother the sediment, reducing water and oxygen exchange and resulting in localised hypoxia and anoxia when they die. Algal blooms have been implicated in mass mortalities of lugworms, e.g. in South Wales where up to 99% mortality was reported (Holt et al. 1995; Olive & Cadman, 1990; Boalch, 1979). Increased nutrients are likely to cause algal

	blooms and subsequent de-oxygenated conditions that may kill a significant part, but not all, of the biota (see oxygenation below). Some species might thrive in increased nutrients.
Habitat structure changes - removal of substratum (extraction)	The biotope is characterized predominantly by benthic species that would be lost as a part of substratum removal and the intolerance is, therefore, high. The mobile species that might be left (especially those living in the water column: mysid shrimps and *Gasterosteus aculeatus*) would not constitute the biotope. For recoverability see additional information below.
Heavy abrasion, primarily at the seabed surface	Both the epibiota and the infauna in the biotope are likely to be intolerance of abrasion, such as dredging or dragging an anchor. Mats of algae will be displaced with any associated species but, in the still conditions that prevail in this biotope, are likely to survive displacement. Soft bodied epifauna, such as ascidians, are most vulnerable, and are likely to suffer mortality. Crabs may be crushed. Fish and mysids in the water column are highly mobile and unlikely to be unaffected directly. The infaunal annelids are predominantly soft bodied, live within a few centimetres of the sediment surface and may expose feeding or respiration structures where they could easily be damaged by a physical disturbance such as a dragging anchor. The species with robust exoskeletons, such as bivalves and crustaceans, are likely to be the most resistant. The overall intolerance of the biotope is recorded as intermediate. The recoverability is assessed to be very high (see additional information below).
Light abrasion at the surface only	
Siltation rate changes	Smothering by 5 cm of sediment would most likely isolate algal growths from the small amount of water movement that exists in this habitat and de-oxygenated conditions with consequent death of algae and animals is likely to occur amongst the algal mats. However, mobile species such as *Asterias rubens*, *Hydrobia ulvae* and *Akera bullata* would most likely dig themselves out of smothering sediment and survive whilst *Arenicola marina* is unlikely to be perturbed by smothering by 5cm of sediment where it occurs on open sediments. Some attached animals are likely to be intolerant. For instance, Dare (1976) reported that mussel beds accumulated ca. 0.4-0.75m of 'mussel mud' (a mixture of silt, faeces, and pseudo-faeces) between May and September 1968 and 1971 in Morecambe Bay. Young mussels moved upwards becoming lightly attached to each other, but many were suffocated. Therefore, it appears that mussels are able to move upwards through accumulated sediment, but that a proportion will succumb. Smothering is not relevant to species in the water column except that food sources may be covered and nests of three-spined sticklebacks affected. There are sufficient species that would be likely to survive for the biotope to be identified as IMX.FiG and so intolerance is recorded as intermediate although recovery may take more than six months. For all species except those in the water column, smothering by impermeable materials would lead to high intolerance.

	Increased levels of suspended sediment will increase turbidity and therefore light penetration (see below) with possibly adverse effects on algal growth. Benthic animal species in the biotope are most likely tolerant of high levels of suspended sediment. For instance, Moore (1977) reported that *Mytilus edulis* was relatively tolerant of turbidity and siltation, thriving in areas that would be harmful to other suspension feeders. *Arenicola marina* is unlikely to be perturbed by increased concentrations of suspended sediment since it lives in sediment and is probably adapted to re-suspension of sediment by wave action or during storms. Animal species in the water column (particularly mysid shrimps and *Gasterosteus aculeatus*) may be adversely affected by high levels of suspended sediment because of its effects on vision (see turbidity below). However, the impact is likely to be short-lived and loss of condition as a result of reduced ability to feed the consequence. Therefore a rank of low intolerance has been reported.
	Decreases in suspended sediment levels may result in reduced food supply for suspension feeding species but will improve light penetration (see turbidity below) and therefore algal growth and will improve the ability of hunting species (mysid shrimps and *Gasterosteus aculeatus*) to catch prey. Overall, it is expected that decreased suspended sediment levels will improve prospects for many species in the biotope.
Introduction or spread of non-indigenous species.	There are microbial parasites that might affect several of the characteristic or commonly occurring species and only examples are given here. The cestode parasite *Schistocephalus solidus* inhibits the female three-spined stickleback from producing clutches of eggs. *Carcinus maenas* may be affected by the parasitic barnacle *Sacculina carcini*. A range of diseases and other potential biological control measures are identified by Goggin (1997) for *Carcinus maenas*. Male *Asterias rubens* are liable to gonad parasitisation by the ciliate parasite *Orchitophrya stellarum* (Vevers, 1951; Bouland & Claereboudt, 1994) that may cause population decline. There are no doubt other pathogens that affect species in the biotope but overall, the biotope is likely to persist as dominant species seem unaffected. The intolerance assessment of low reflects the possibility that viability and condition of several species in the biotope may be affected.
Introduction of microbial pathogens	The presence of Beggiatoa sp. in the biotope suggests that de-oxygenated pockets occur and that hypoxia may be a feature that component species need to be tolerant of. For instance, *Arenicola marina* has been found to be unaffected by short periods of anoxia and to survive for 9 days without oxygen (Borden, 1931 and Hecht, 1932 cited in Dales, 1958; Hayward, 1994). Therefore, *Arenicola marina* is likely to have a low intolerance if exposed to oxygen concentration as down to 2mg/l (the benchmark). Many others benthic species can move away but algae may be affected by severe de-oxygenation. At the level of the benchmark, some mortality of fixed species might occur but, because of tolerance of many species and the ability to move away of others, the biotope should persist during the one week the bench mark level of 2 mg/l persists. In conditions of more severe hypoxia or anoxia, the biotope might become CMU.Beg (Beggiatoa spp. on anoxic sublittoral mud).
Removal of target habitat	There are no non-native species known from this biotope or likely to invade it.

Removal of non-target habitat	*Arenicola marina* might be subject to some extraction by bait diggers especially at the shallow margins of the habitat. McLusky et al. (1983) examined the effects of bait digging on blow lug populations in the Forth estuary. Dug and infilled areas and unfilled basins left after digging re-populated within 1 month. However, bait digging may also disturb the filamentous algal cover although recolonization would be expected to be rapid (see displacement).Where present, *Mytilus edulis* may also be extracted and accordingly, intolerance has been assessed as intermediate. Recovery is expected to be high (see additional information).

2.13	**Kelp and seaweed communities on sublittoral sediment IMX.LsacX**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The species present in the biotope are widely distributed in the north-east Atlantic and are therefore well-within their limits of tolerance in the British Isles. Some minor mortality may occur. For instance, mature sporophytes of *Saccharina latissima* (studied as *Laminaria saccharina*) from the Isle of Man have been found to have an upper temperature tolerance of 17°C (Kain 1979). In the unusually hot summer of 1983, when temperatures were 8.3°C higher than normal, *Saccharina latissima* (studied as *Laminaria saccharina*) showed signs of bleaching (Hawkins & Hartnoll, 1985). The response of *Asterias rubens* to prolonged exposure to unusually high temperatures is arm shedding (autotomy) then death (Schäfer, 1972). Starfish have also been found dead in isolated rock pools during prolonged emersion in calm hot weather, the suspected cause of death being increased water temperature (references in Lawrence, 1995). For *Arenicola marina*, Wilde & Berghuis (1979) reported 50% mortality of juveniles reared at 20°C and 90% at 25°C. Sommer et al. (1997) examined sub-lethal effects of temperature and suggested a critical upper and lower temperature of 20°C and 5 °C respectively in North Sea specimens. However, in subtidal populations of all species, effects of temperature increase are likely to be reduced compared with intertidal areas. Recoverability is likely to be rapid for the majority of species (see Additional information below).
Temperature changes - local decrease	The species present in the biotope are widely distributed in the north-east Atlantic and are well-within their limits of tolerance in the British Isles. Some species may be affected although not those characteristic of or visually dominant in the community. Following the cold winter of 1962-63, of the characteristic animal species in the biotope, only *Lanice conchilega* and *Carcinus maenas* were noted as having been adversely affected (Crisp, 1964). Recoverability is likely to be rapid for the majority of species (see Additional information below).
Salinity changes - local increase	The biotope is found in full or variable salinity. Increase in salinity above full salinity is not considered likely and so 'not relevant' is indicated.

Water flow (tidal current) changes - local increase	The main water movement factor important for this biotope is wave action. However, increased tidal flow may cause drag on large seaweeds which in turn may dislodge the substratum to which they are attached, especially likely in *Saccharina latissima*. Plants may be lost from the biotope and be displaced to less favourable situations. It is unlikely that the mobile and burrowing species in the biotope will be adversely affected. Since some of the key characterizing species are likely to be lost, intolerance is indicated as Intermediate. Although some *Saccharina latissima* might be lost and some mobile species migrate away temporarily, some plants are likely to remain and animals migrate back so recoverability is likely to be very high (see Additional information below).
Water flow (tidal current) changes - local decrease	Tidal flow is important in the absence of strong wave action for keeping the biotope clean of silt. Decrease in water flow is likely to facilitate siltation which will reduce photosynthesis in plants and may cause smothering of some attached benthic species.
Emergence regime changes - local increase	Increased emergence will result in desiccation (see desiccation).
Emergence regime changes - local decrease	The biotope is subtidal except when exposed at extreme low water of spring tides when desiccation might have an unfavourable effect. Therefore, any decrease in emergence is likely to be favourable and allow the biotope to increase in extent.
Wave exposure changes - local increase	The substratum type in the biotope is determined mainly by wave exposure regime. Increase in wave exposure is likely to disturb the substratum destroying some attached species through abrasion. It may also winnow away finer sediments creating a different substratum. Recoverability is likely to be rapid for the majority of species (see Additional information below).
Wave exposure changes - local decrease	Wave action is important for keeping the biotope clean of silt. Decrease in wave action is likely to facilitate siltation which will reduce photosynthesis in plants and may cause smothering (see Smothering, although depth of silt would not be expected to be as high as the benchmark).
Water clarity increase	Low turbidity will enable the biotope to establish at greater depths than in higher turbidity regimes so that, in a year with low turbidity, the biotope may be more extensive than in a year with high turbidity. Since algae from normally shallow well-lit depths will be able to grow in deeper water, the species diversity in that deeper water is likely to be higher. However, higher algal cover may exclude some animal species although species richness is unlikely too be adversely affected.
Water clarity decrease	High turbidity at the time of year when settlement of algal spores and growth mostly occurs will depress the amount of algal cover present although not necessarily species richness.
Habitat structure changes - removal of substratum (extraction)	Substratum removal will remove the biotope including the attached species that mainly characterize it. Recoverability is likely to be rapid for the majority of species (see Additional information below).

<table>
<tr><td>Heavy abrasion, primarily at the seabed surface</td><td rowspan="2">Some species, especially attached algae, are likely to be removed by physical disturbance equivalent to a passing scallop dredge. However, many characteristic animal species are mobile or infaunal and so are likely to avoid most effects of surface disturbance. Therefore, an intolerance of intermediate has been recorded. Recoverability is likely to be rapid for the majority of species (see additional information below).</td></tr>
<tr><td>Light abrasion at the surface only</td></tr>
<tr><td rowspan="3">Siltation rate changes</td><td>The time of year at which smothering occurred would be important. Smothering at the time spores of colonizing species were settling might reduce their abundance significantly. However, once grown, algae would protrude above silt. The biotope is significantly characterized by mobile species that would burrow out of a covering of silt or other material. However, some species will be covered and if de-oxygenation occurred it would cause mortality. Recoverability is likely to be rapid for the majority of species (see Additional information below).</td></tr>
<tr><td>Silt falling onto algal fronds is likely to reduce photosynthesis but not cause mortality. An increase in the level of suspended sediment was found to reduce growth rate of Saccharina latissima (studied as Laminaria saccharina) by 20% (Lyngby & Mortensen, 1996). Adults appear to tolerate silt because they are found in areas of siltation (Birkett et al., 1998). It might also be that feeding in suspension feeding animals, such as Ascidiella aspersa, might be adversely affected. However, most animals characterizing the biotope are grazers, predators and scavengers.</td></tr>
<tr><td>Decrease in siltation is likely to improve growth of the dominant members of the community (algae) as lack of silt on fronds will enable more efficient photosynthesis. Suspension feeding animal species rely on plankton not silt and so are unlikely to be affected.</td></tr>
<tr><td>Visual disturbance</td><td>The characteristic and dominant species in this biotope are seaweeds and are not sensitive to visual presence. Some fish that inhabit the biotope may be intolerant and may seek shelter but will not be affected in the long term.</td></tr>
<tr><td>Introduction or spread of non-indigenous species.</td><td>It is not expected that microbial pathogens will significantly affect the biotopes and little information has been found. Saccharina latissima may be infected by the microscopic brown alga Streblonema aecidioides. Infected algae show symptoms of Streblonema disease, i.e. alterations of the blade and stipe ranging from dark spots to heavy deformations and completely crippled thalli (Peters & Scaffelke, 1996). Infection can reduce growth rates of host algae.</td></tr>
<tr><td>Introduction of microbial pathogens</td><td>The effect of low oxygen levels on the main characteristic species in this biotope, seaweeds, is poorly studied. Where local deoxygenation occurs rotten seaweed is characteristic. Animals may be intolerant of reduction in oxygen. However, at the benchmark level of reduction below 4 mg/l, it is not expected that significant adverse effects will occur to the biotope as there is always some water motion (from waves or tides) in this biotope.</td></tr>
<tr><td>Removal of target habitat</td><td>This biotope is likely to be colonized by the non-native wireweed Sargassum muticum. However, in this predominantly subtidal biotope, Sargassum muticum tends to occupy minimal space on the seabed and not displace other species. However, the biotope may also be colonized by the slipper limpet Crepidula fornicata which is likely to significantly change the character of the substratum through production of pseudofaeces and by displacing other species. Therefore, intolerance is ranked as high. The presence of shells of slipper</td></tr>
</table>

	limpets and the increased muddiness of the sediment is likely to change the substratum for some time and the biotope may not return rapidly to its original condition until the substratum reverts to pre-Crepidula character.
Removal of non-target habitat	Neither *Chorda filum* nor *Saccharina latissima* are thought to be currently targeted for extraction in the UK and we have no evidence for the indirect effects of extraction of other species on this biotope.

2.13	**Kelp and seaweed communities on sublittoral sediment MIR.LsacChor**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The species present in the biotope are widely distributed in the north-east Atlantic and are therefore well-within their limits of tolerance in the British Isles. Mature sporophytes of *Saccharina latissima* (studied as *Laminaria saccharina*) from the Isle of Man have been found to have an upper temperature tolerance of 17°C (Kain 1979). In the unusually hot summer of 1983, when temperatures were 8.3°C higher than normal, *Saccharina latissima* (studied as *Laminaria saccharina*) showed signs of bleaching (Hawkins & Hartnoll, 1985). However, in subtidal populations, effects are likely to be reduced compared with intertidal areas.
Temperature changes - local decrease	The species present in the biotope are widely distributed in the north-east Atlantic and are well-within their limits of tolerance in the British Isles. For instance, the minimum temperature required for growth and reproduction of *Saccorhiza polyschides* is 5°C. The 'northern lethal boundary' of the species occurs where the temperature falls below 4°C for a period of 2 months (Hoek van den, 1982). Some species may be affected although not those characteristic of or visually dominant in the community.
Salinity changes - local increase	The biotope is found in full or nearly full salinity.
Water flow (tidal current) changes - local increase	The main water movement factor important for this biotope is wave action. However, increased tidal flow may cause drag on large seaweeds which in turn may dislodge the substratum to which they are attached. Plants may be lost from the biotope and be displaced to less favourable situations.
Water flow (tidal current) changes - local decrease	Tidal flow is important in the absence of strong wave action for keeping the biotope clean of silt. Decrease in water flow is likely to facilitate siltation which will reduce photosynthesis in plants and may cause smothering.
Emergence regime changes - local increase	Increased emergence will result in increased risk of desiccation (see desiccation) and exposure to greater extremes of temperature. In the part of the biotope subject to increased emergence, characterizing species will most likely die and an intolerance of High is therefore given. For recoverability, see Additional Information
Emergence regime changes -	The biotope is subtidal except when exposed at extreme low water of spring tides when desiccation might have an unfavourable effect. Therefore, any decrease in emergence is likely to be favourable.

local decrease	
Wave exposure changes - local increase	The substratum type in the biotope is determined mainly by wave exposure regime. Increase in wave exposure is likely to disturb the substratum destroying some attached species through breakage or abrasion. It may also winnow away finer sediments creating a different substratum. For recoverability, see Additional Information.
Wave exposure changes - local decrease	Wave action is important for keeping the biotope clean of silt. Decrease in wave action is likely to facilitate siltation which will reduce photosynthesis in plants and may cause smothering.
Water clarity increase	Low turbidity will enable the biotope to establish at greater depths than in higher turbidity regimes so that, in a year with low turbidity, the biotope may be more extensive than in a year with high turbidity. Since algae from normally shallow well-lit depths will be able to grow in deeper water, the species diversity in that deeper water is likely to be higher.
Water clarity decrease	High turbidity at the time of year when settlement of algal spores and growth mostly occurs will depress the amount of algal cover present although not necessarily species richness. The overall effect will be a lower cover particularly of ephemeral algal species.
Habitat structure changes - removal of substratum (extraction)	The community will be removed with the substratum and so intolerance is high. For recoverability, see Additional Information.
Heavy abrasion, primarily at the seabed surface	This is a biotope that exists because of physical disturbance of mobile substrata. The community is likely to be destroyed by severe storms but will regenerate the following spring when conditions of wave action usually settle down. It might be that the biotope develops in a largely undisturbed way until the next sever storm, perhaps after several years. If disturbance occurs 'out-of-season', the biotope will be adversely affected for the remainder of the year. '
Light abrasion at the surface only	
Siltation rate changes	The time of year at which smothering occurred would be important. Smothering at the time spores of colonizing species were settling might reduce their abundance significantly. However, once grown, the algae would protrude above silt. Other species such as encrusting seaweeds, tube worms and barnacles would be likely to survive under silt for the benchmark of three weeks although if de-oxygenation occurred it would cause mortality. For recoverability, see Additional Information.

	Increase in the level of suspended sediment mainly affects suspension feeding animal species. It might also be that feeding in suspension feeding animals will be adversely affected. Light penetration will also be affected (see 'Turbidity) and siltation is more likely to occur. Silt falling onto algal fronds is likely to reduce photosynthesis but not cause mortality. An increase in the level of suspended sediment was found to reduce growth rate of *Saccharina latissima* (studied as *Laminaria saccharina*) by 20% (Lyngby & Mortensen, 1996). Adults appear to tolerate silt because they are found in areas of siltation (Birkett et al., 1998). Norton (1978) observed that silt settling out on already attached spores prevented the formation of gametophytes in *Saccorhiza polyschides* sporophytes so that some damaging effects might occur.
	Decrease in siltation is likely to improve growth of the dominant members of the community (algae) as lack of silt on fronds will enable more efficient photosynthesis. Suspension feeding animal species rely on plankton not silt and so are unlikely to be affected.
Underwater noise changes	The characteristic and dominant species in this biotope are seaweeds and are not sensitive to noise. Some fish that inhabit the biotope may be sensitive and may seek shelter but will not be affected in the long term.
Visual disturbance	The characteristic and dominant species in this biotope are seaweeds and are not sensitive to visual presence. Some fish that inhabit the biotope may be intolerant and may seek shelter but will not be affected in the long term.
Introduction or spread of non-indigenous species.	It is not expected that microbial pathogens will significantly affect the biotopes and little information has been found. *Saccharina latissima* may be infected by the microscopic brown alga *Streblonema aecidioides*. Infected algae show symptoms of Streblonema disease, i.e. alterations of the blade and stipe ranging from dark spots to heavy deformations and completely crippled thalli (Peters & Scaffelke, 1996). Infection can reduce growth rates of host algae.
Introduction of microbial pathogens	The effect of low oxygen levels on the main characteristic species in this biotope, seaweeds, is poorly studied. Where local deoxygenation occurs rotten seaweed is characteristic. Animals may be intolerant of reduction in oxygen. However, at the benchmark level of reduction below 2 mg/l, it is not expected that significant adverse effects will occur to the biotope as there is always some water motion (from waves or tides) in this biotope.
Removal of target habitat	The biotope is likely to be colonized by wireweed *Sargassum muticum* which occupies space but not to the exclusion of native species.
Removal of non-target habitat	Extraction of *Saccharina latissima* may occur but the plant rapidly colonizes cleared areas of the substratum: Kain (1975) recorded that *Saccharina latissima* (studied as *Laminaria saccharina*) was abundant six months after the substratum was cleared so recovery should be rapid. Associated species are unlikely to be affected by removal of *Saccharina latissima* unless protection from desiccation on the lower shore is important. Little evidence has been found on the impact of extraction of *Chorda filum* although the species is harvested in Japan. However, if removed, recovery should also be rapid. Intolerance has been assessed as intermediate to reflect some possible loss although recovery is expected to be high.

2.14	Littoral chalk communities MLR.BF
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The biotope occurs in warmer and colder parts of Britain and Ireland and similar assemblages of species are known to occur in Norway, Canada and Brittany so that long-term temperature change is unlikely to cause a change in biotope. Schonbeck & Norton (1979) demonstrated that fucoids can increase tolerance in response to gradual change in a process known as 'drought hardening'. However, fucoids are more intolerant of sudden changes in temperature and relative humidity with field observations of bleaching and death of plants during periods of hot weather (Hawkins & Hartnoll, 1985). All other key species are moderately tolerant of temperature changes at the benchmark level and so intolerance of the biotope is assessed as intermediate. Larvae and juvenile individuals are likely to be more intolerant of changes in temperature than adults. Changes in the numbers of the key structuring species are likely to have profound effects on community structure.
Salinity changes - local increase	Barnacle and fucoid shores are able to tolerate short term variations in salinity because the littoral zone is regularly exposed to precipitation. All key species are able to penetrate in to lower salinity estuarine waters, down to about 20psu so the biotope can tolerate long term reductions in salinity within its normal tolerance range although growth rates and fecundity are likely to be impaired. However, some of the other species within the biotope may be highly intolerant of changes in salinity resulting in a loss of diversity. However most species have planktonic larvae so recolonization and recovery should be high.
Water flow (tidal current) changes - local increase	Significant increases in water flow rate may cause some of the macroalgal populations to be torn off the substratum. On the lower shore however, increased water movement encourages several filter feeding faunal groups, such as sponges and ascidians, to occur and species richness may increase. The effect of a decrease in water flow rate is likely to be low because the biotope is also found on shores with low water flow. However, barnacle growth rates are lower in reduced water flow and this may affect the balance of the barnacle-fucoid mosaic, perhaps promoting fucoid dominated shores such that MLR.BF becomes replaced by another biotope such as SLR.Fserr.
Emergence regime changes - local increase	A change in the level of emergence on the shore will affect the upper or lower distribution limit of all the key species. Changes in the numbers of important species are likely to have profound effects on community structure and may result in loss of the biotope at the extremes of its range. For example, at the upper limit the biotope may lose fucoid cover and so change to one dominated by barnacles and limpets such as ELR.MB.Bpat.

Wave exposure changes - local increase	The effect of changes in wave action on barnacle and fucoid community stability is predominantly through its influence on the balance of the biological interactions. In increasing wave action, fucoids may be removed and grazers and barnacles are favoured at the expense of the fucoids, and a stable situation with minimal fucoid cover prevails. *Ascophyllum nodosum*, in particular is very intolerant of increased wave exposure. Conversely, if wave exposure reduces fucoids are favoured and maintain a more or less total and permanent canopy (Hartnoll & Hawkins, 1985). Thus, if wave exposure changes the biotope can rapidly disappear to be replaced by another, barnacle dominated on extremely exposed shores (ELR.Bpat) and dense fucoid cover on sheltered shores (SLR.F.Fser). The loss of fucoid plants results in the loss of structural complexity and invertebrate species diversity may decline in the absence of microhabitats and refugia.
Water clarity decrease	Intolerance to turbidity is low because the key species are relatively tolerant of changes in turbidity and the biotope is also found in areas of low water flow where turbidity is likely to be high. An increase in turbidity may reduce algal growth rates because of increased light attenuation although because photosynthesis also occurs during emersion the effect may not be significant. There may be some clogging of suspension feeding apparatus in some species although characteristic species survive in occasionally very turbid conditions and increased turbidity often means an increase in available food particles.
Habitat structure changes - removal of substratum (extraction)	All key and important species in the biotope are highly intolerant of substratum loss. The algae and barnacles are permanently attached to the substratum so populations would be lost. Epifaunal grazers like *Patella vulgata* and littorinid snails are epifaunal and substratum loss causes increased risk of desiccation and predation and so populations are unlikely to survive. Mobile species like the amphipod *Hyale prevostii* will be indirectly affected by the loss of fucoid plants as will sessile epiphytic flora and fauna. Recovery is good because recruitment of key species, with the exception of *Ascophyllum nodosum*, is fairly rapid so that the biotope will look much as before within five years. However, it can take between 10 and 15 years for the natural variation in community structure of the biotope to return to normal after significant mortality of key species such as seen after the Torrey Canyon oil spill (Southward & Southward, 1978).
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	The rocky intertidal is not at risk from boating activity but is susceptible to abrasion and physical impact from trampling. Even very light trampling on shores in the north east of England was sufficient to reduce the abundance of fucoids (Fletcher & Frid, 1996) which, in turn reduced the microhabitat available for epiphytic species. Trampling damage is particularly serious for the long-lived but slowly recruiting *Ascophyllum nodosum*. Light trampling pressure, of 250 steps in a 20x20 cm plot, one day a month for a period of a year, has also been shown to damage and remove barnacles (Brosnan & Crumrine, 1994). Trampling pressure can thus result in an increase in the area of bare rock on the shore (Hill et al., 1998). Chronic trampling can affect community structure with shores becoming dominated by algal turf or crusts. However, if trampling stops, recovery should be good. In Oregon for example, the algal-barnacle community recovered within a year after trampling stopped (Brosnan & Crumrine, 1994).

Siltation rate changes	A 5cm layer of sediment or debris on a barnacle and fucoid shore is likely to reduce photosynthesis of algae and may cause some plants to rot. Sediment will have an especially adverse effect on young germling algae and on the settlement of larvae and spat. Barnacle feeding may be affected and limpet locomotion and grazing may be impaired. Lower down the shore active suspension feeders such as sponges and mussels may be killed by smothering. However, since wave action on rocky shores is likely to mobilise sediment alleviating the effect of smothering intolerance has been assessed as intermediate. Most characterizing species have planktonic larvae and/or are mobile and so can migrate into the affected area so recovery should be high.
	The biotope is likely to have some tolerance of suspended sediment and siltation as it is also found on sheltered shores where siltation may occur and key species in the biotope have low intolerance to the factor. However, suspended sediment may clog respiratory and feeding organs of other species such as sea squirts and spirorbid worms and so epifaunal species composition may change if suspended sediment changes significantly.
Introduction or spread of non-indigenous species.	The cryptoniscid isopod *Hemioniscus balani* is a wide spread parasite of barnacles, found around the British Isles. Heavy infestation inhibits or destroys the gonads resulting in castration of the barnacle. High levels of infestation may reduce barnacle abundance and distribution which would impact on patch dominance although no reported cases of this were found.
Introduction of microbial pathogens	Cole et al. (1999) suggest possible adverse effects on marine species below 4 mg/l and probable adverse effects below 2 mg/l. There is no information about key algae species tolerance to changes in oxygenation although Kinne (1972) reports that reduced oxygen concentrations inhibit both algal photosynthesis and respiration. Sensitive species, such as the amphipod *Hyale prevostii*, may be lost resulting in a reduction in diversity.
Removal of target habitat	The Australasian barnacle *Elminius modestus* does well in estuaries and bays where it can displace the native *Semibalanus balanoides*. Its overall effect on the dynamics of rocky shores has however, been small as *Elminius modestus* has simply replaced some individuals of a group of co-occurring barnacles (Raffaelli & Hawkins, 1999).
Removal of non-target habitat	Both *Fucus serratus* and *Ascophyllum nodosum* are harvested within the UK and the extraction of either of these species will have a significant impact on community structure of the biotope. Removal of algal species will result in loss of micro-habitats for other species and, hence, a reduced faunal diversity. However, the loss will favour the barnacles which would be expected to increase in abundance. It is extremely unlikely that any of the other species indicative of sensitivity would be targeted for extraction and overall, an intermediate intolerance has been suggested. Recovery should be high because the key species have a dispersive larval stage and reproduce every year. However, a return to normal community structure dynamics after removal of all key species appears to take much longer, 10 and possibly up to 15 years (Southward & Southward, 1978).

2.14	Littoral chalk communities LR.CHr
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Anand (1937c) examined the range of temperatures experienced by chalk cliff algal communities. The *Pseudendoclonium submarinum* belt was exposed to temperatures slightly less than air (since the cliff face heats up slowly) but similar variability in temperature to that of the air. The mucilaginous Chrysophyceae belt was consistently lower in temperature than the air and was least affected by changes in air temperature and showed no marked variation over several hours. Anand (1937c) concluded that its water content and retention acted as a buffer against temperature change. Curiously, in contrast, the *Ulva* sp. and *Fucus* sp. belts of the lower shore showed a much greater range of temperatures, especially in bright sunlight. However, Anand (1937b&c) also noted that prolonged exposure to high temperatures during summer in desiccating conditions resulted in death, cracking and peeling off of the 'Chrysophyceae' belt. The mat was seldom seen to crack in areas sheltered from direct sunlight and/or wind. Overall, therefore an increase in annual temperatures (at the bench mark level) is likely to increase the risk of desiccation and exposure to high temperatures during summer, resulting in loss of the proportion of the population depending on its shelter and aspect. Hence, an intolerance of intermediate has been recorded. Once prior conditions return, recovery is likely to be rapid (see additional information below).
Temperature changes - local decrease	Anand (1937b&c) reported that light brown or white patches appeared in the 'Chrysophyceae' mat during winter due to frost. However, little other information concerning low temperatures was found. A decrease in annual winter temperatures is likely to increase the risk of frost, however, a reduction in average summer temperatures, will reduce the risk of desiccation. Since the Chrysophyceae communities are best developed in winter and the associated Cyanobacteria communities develop in spring and summer the biotope as a whole may benefit from a reduction in average summer temperatures. Therefore, not sensitive* has been recorded.
Salinity changes - local increase	Although not covered by seawater, the supralittoral experiences a wide range of salinities due to the evaporation of wave splash and spray, resulting in high salt concentrations, and exposure to rain and freshwater runoff. Anand (1937c) showed that the salt concentration in the 'Chrysophyceae' belt was higher than in the *Ulva* sp. Belt (lower on the shore) but (due to water retention) did not experience as great an increase in salt concentration once the tide fell. However, in the 'Chrysophyceae' belt the salt concentration may be approximately 3 times that of seawater (Anand, 1937c). Therefore, since soft rock algal communities are also likely to be exposed to fresh water in the form of rain, this biotope is probably not intolerant of changes in salinity comparable to the benchmark.
Salinity changes - local decrease	See above

Water flow (tidal current) changes - local increase	This biotope is never directly covered by the sea and is, therefore, not affected by water flow rates.
Water flow (tidal current) changes - local decrease	This biotope is never directly covered by the sea and is, therefore, not affected by water flow rates.
Emergence regime changes - local increase	An increase in emergence will result in a reduction in the height reached by wave splash and spray. Hence, the height of the algal communities in the supralittoral will also be reduced, resulting in the biotope effectively moving down the shore. Some species particularly abundant in more moist conditions may be lost. Therefore, the extent or abundance of the biotope is likely to be reduced and an intolerance of intermediate has been recorded at the benchmark level. However, physical removal from the effects of the sea (wave splay and spray) for long periods of time, e.g. by coastal defences has been shown to result in loss of suitable environmental conditions and loss of the biotope (see importance; Fowler & Tittley, 1993; Anon, 1999e). Once prior conditions return, recovery is likely to be rapid (see additional information below).
Emergence regime changes - local decrease	A decrease in emergence equivalent to a 1 hour change cover by the sea (see benchmark) would expose the habitat to an increased level of spray. However, decreased emergence will allow the algal communities to colonize further up the shore, so that the entire zonation (see habitat complexity) will probably move up the shore. Therefore, an intolerance of low has been recorded.
Wave exposure changes - local increase	The height and extent of the supralittoral, and hence the communities it supports is dependant on wave wash, splash and spray, and therefore, wave exposure. Anand (1937b&c) noted that the *Pseudendoclonium submarinum* belt could reach up to 8-10m above high water but in caves or recesses where waves break and create more spray the algal communities could extend higher up the shore. Similarly, Lewis (1964) noted that the supralittoral could reach 50-60 ft above mean high water springs on wave exposed North Atlantic headlands. Increased wave exposure is likely to increase the overall height of the supralittoral and increase the height and extent of the associated algal communities. Therefore, not sensitive* has been recorded. Increased spray may also allow a more diverse community to develop resulting in a rise in species richness.
Wave exposure changes - local decrease	The height and extent of the supralittoral, and hence the communities it supports is dependant on wave wash, splash and spray, and therefore, wave exposure. A decrease in wave exposure is likely to reduce the height of the supralittoral and hence the extent of its associated algal communities. Therefore, an intolerance of intermediate has been recorded. Once prior conditions return, recovery is likely to be rapid (see additional information below).
Water clarity increase	This biotope is never directly covered by the sea and is, therefore, not affected by changes in turbidity.
Water clarity decrease	This biotope is never directly covered by the sea and is, therefore, not affected by changes in turbidity.
Radionuclide	Insufficient information

contamination	
De-oxygenation	This biotope is exposed to the air and therefore unlikely to experience hypoxia or anoxia.
Nutrient enrichment	Maritime cliff plant and algae communities are probably nutrient poor, i.e. lack nutrients. A increase in nutrients in the form of runoff from adjacent agricultural land may benefit the communities. However, the opportunistic filamentous algae such as *Ulothrix* sp. and *Urospora* sp. and even *Pseudendoclonium submarinum* may overgrow the 'Chrysophyceae' belt, resulting in the dominance of a few species at the expense of a more diverse community. However, no information concerning the effects of nutrient enrichment on these communities was found and no intolerance assessment was recorded.
Habitat structure changes - removal of substratum (extraction)	Removal of the substratum will result in the removal and loss of the biotope. Therefore, an intolerance of high has been recorded. Rock falls may be a natural dynamic feature of this biotope resulting in loss of areas of substratum and its associated biotopes but revealing new substratum for colonization. However, where the substratum is modified, e.g. by coastal defence structures, recovery may not be possible (see importance). The microalgae within this biotope can probably colonize new substratum and grow rapidly, probably within a year (see additional information below). Therefore a recoverability of high has been recorded.
Heavy abrasion, primarily at the seabed surface	The 'Chrysophyceae' mat is very thin (a few millimetres) and the *Pseudendoclonium submarinum* belt exists as a thin coasting of the rock. These algal communities are likely to be removed as a result of any abrasion, e.g. from stranding or trampling, especially where the friable rock surface is removed. Therefore, an intolerance of intermediate has been recorded. However, recovery is likely to be rapid if suitable substratum remains (see additional information below).
Light abrasion at the surface only	
Siltation rate changes	Smothering could occur as a result of rainwater runoff of silt and soil from the tops of the cliffs. However, the slope of the cliff would preclude the build up of significant deposits (except on crevices and pits) sufficient to block the algal communities access to sunlight. Therefore, the factor is probably not relevant at the level of the benchmark. Smothering by impermeable materials or by other hard construction materials, however, would result in loss of the biotope.
	This biotope is unlikely to be affected by changes in suspended sediment since it is only exposed to wave splash or spray. Therefore, this factor is probably not relevant. However, it may be covered in silt due to heavy rainfall (see smothering above).
	This biotope is unlikely to be affected by changes in suspended sediment since it is only exposed to wave splash or spray. Therefore, this factor is probably not relevant. However, it may be covered in silt due to heavy rainfall (see smothering above).
Visual disturbance	Microalgae can orientate themselves to light when motile. However, visual acuity is probably non-existent and they are unlikely to respond to visual presence or periodic shading, especially when fixed to the substratum in the form of a thallus.
Introduction or spread of non-indigenous	No information found

species.	
Introduction of microbial pathogens	This biotope is exposed to the air and therefore unlikely to experience hypoxia or anoxia.
Removal of target habitat	No information found
Removal of non-target habitat	Soft rock algal communities are unlikely to be subject to extraction.

2.14	**Littoral chalk communities MIR.LdidPid**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	*Laminaria digitata* is a eurythermal species with sporophytes growing over a wide temperature range. Lüning (1984) detected a seasonal shift in heat tolerance of *Laminaria digitata* plants in Helgoland of 2°C between spring and summer so the species is likely to be relatively tolerant of a long term, chronic change in temperature. However, the biotope may be intolerant of rapid changes in temperature outside its tolerance range. During an exceptionally warm summer in Norway, Sundene (1964) reported the destruction of *Laminaria digitata* plants exposed to temperatures of 22-23°C. In Scotland, when spring low tides coincided with night time extreme air frosts on several consecutive days, mortality of all but the lowest shore adult *Laminaria digitata* plants occurred (Todd & Lewis, 1984). Therefore, the biotope is likely to be of intermediate intolerance to short term acute temperature change. Loss of plants will result in reduces species diversity.
Salinity changes - local increase	Kelps are stenohaline seaweeds, in that they do not tolerate wide fluctuations in salinity (Birkett et al., 1998b) although *Laminaria digitata* has been reported to grow in salinities of 25psu. The biotope occurs in situations that are naturally subject to fluctuating salinity because of precipitation but kelp growth rates may be adversely affected if subjected to periodic salinity stress. Localized, long term reductions in salinity, to below 20 psu, may result in the loss of kelp beds in affected areas and thus loss of the biotope (Birkett et al., 1998). Other species within the biotope may be intolerant of large salinity changes resulting in reduced species diversity.

Water flow (tidal current) changes - local increase	The biotope occurs in a wide range of water flow environments, from very weak to moderately strong and so will be relatively tolerant of changes. In areas of very strong water flow it is often out-competed by *Alaria esculenta* and in much slower water by *Saccharina latissima*. *Laminaria digitata* is not found in areas subject to sand scouring. Water motion affects light by moving canopies and influences the impact of sedimentation and scour and importantly water motion determines the availability of nutrients. It is unlikely that species in the biotope will be killed by an increase or decrease in flow rate. Existing organisms are likely to persist although conditions will not be ideal. Decreased water flow will lead to a reduced competitive advantage for suspension feeding animals especially sponges which will decline in growth rate.
Emergence regime changes - local increase	The biotope is predominantly sublittoral and so a change in the emergence regime at the benchmark level (one hour in the time covered or not covered by the sea for a period of 1 year) is likely to result in a depression of the upper limit of the biotope. Some sessile species, such as sea squirts, are unlikely to survive a long term increase in emergence. Many of the subordinate species, especially solitary sea squirts, are unlikely to survive an increased emergence regime and mobile species are likely to move away so that species diversity will decline. However, in the presence of a suitable substratum the biotope is likely to re-establish further down the shore. Kain (1975) recorded that *Laminaria digitata* had recolonized cleared rocks within 2 years so recovery should be high. Most other characterizing species have planktonic larvae and/or are mobile and so can migrate into the affected area. Growth rates of sessile species in the biotope are generally rapid. For instance, *Halichondria panicea* increases by about 5% per week (Barthel, 1988).
Wave exposure changes - local increase	The biotope occurs in areas of moderate wave exposure. Although the kelp *Laminaria digitata* can tolerate a wide range of wave exposures a significant increase in wave exposure will have a detrimental effect on the biotope because of the friable nature of the substratum resulting in a loss of sessile species. Changes in wave exposure may also interfere with feeding for the piddocks, *Polydora ciliata* and other suspension feeding organisms.
Water clarity decrease	Changes in turbidity may affect the distribution or growth rates of *Laminaria digitata* and other algae. Reduced turbidity may increase productivity of kelps and other algae but is not expected to increase the depth range to which the biotope extends because limiting conditions for the depth to which *Laminaria digitata* can grow are not usually to do with light, but due to competition with the truly sublittoral kelp *Laminaria hyperborea*. Increases in turbidity around a sewage treatment plant was thought to be responsible for the absence of *Laminaria digitata* plants in the Firth of Forth (Read et al., 1983) and has been reported to result in a reduced depth range and the fewer new plants under the kelp canopy. An increase in turbidity will reduce photosynthesis and growth of plants. On return to normal turbidity levels the growth rate would be quickly return to normal. In almost all cases not involving canopy competition, irradiance is most severely reduced by suspended particles in the water column (Dayton, 1985). There may be some clogging of suspension feeding apparatus in sea squirts, brittle stars and feather stars although those groups survive in occasionally very turbid conditions. Species richness may decline in the long-term.

Non-synthetic compound contamination (incl. heavy metals)	No information is available on the effect of heavy metals on the biotope. Intolerance of the key species is reported as intermediate, with likely effects on growth and fecundity, so biotope intolerance is assessed as intermediate. There may be a decline in overall species diversity with long term heavy metal pollution.
Non-synthetic compound contamination (incl. hydrocarbons)	No significant effects of the Amoco Cadiz spill were observed for Laminaria populations and the World Prodigy spill of 922 tons of oil in Narragansett Bay had no discernible effects on *Laminaria digitata* (Peckol et al., 1990). However, analysis of kelp holdfast fauna after the Sea Empress oil spill in Milford Haven illustrated decreases in number of species, diversity and abundance at sites nearest the spill (SEEEC, 1998). It is also expected that other species in the biotope will be intolerant of hydrocarbons. A proliferation of polychaete worms often follows oil spills. A major decline in species diversity within the biotope is likely and so intolerance is reported as intermediate.
Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Several of the species characteristic of the biotope are reported as having high intolerance to synthetic chemicals. For instance, Cole et al. (1999) suggests that herbicides such as Simazina and Atrazine are very toxic to macrophytic algae. Hiscock and Hoare (1974) noted that almost all red algal species were absent from areas adjacent to an acidified halogenated effluent in Amlwch Bay, North Wales. Red algae have also been found to be sensitive to oil spill dispersants (O'Brien & Dixon, 1976). Bivalve molluscs, such as piddocks are reported to be very intolerant of TBT contamination (see *Pholas dactylus* review) with reduced abundance and growth reported in the field and laboratory. Other species in the biotope, in particular polychaete worms, are much more tolerant of chemical pollutants. The tube dwelling polychaetes *Polydora ciliata* and *Pomatoceros triqueter*, for example, flourished close to the Amlwch Bay bromide extraction plant effluent (Hoare & Hiscock, 1974). Therefore, the result of an increase in synthetic chemicals within the biotope is likely to be the death of several of the more intolerant species, including key species such as *Pholas dactylus*. Abundance of other more pollution tolerant species, especially polychaete worms, is likely to increase. The overall impact is one of the probable loss of key species and a major decline in species diversity and the intolerance of the biotope is therefore reported as high. Recovery is good because recolonization of algae takes place within 2 years and most fauna have pelagic larvae and so can recolonize rapidly.
Radionuclide contamination	Insufficient information.
Nutrient enrichment	The growth of macroalgae in temperate coastal waters is generally expected to be limited by nitrogen in the summer period. In Helgoland, where ambient nutrient concentrations are double those of the Scotland site *Laminaria digitata* grows in the summer months. Higher growth rates have also been associated with plants situated close to sewage outfalls. However, after removal of sewage pollution in the Firth of Forth, *Laminaria digitata* became abundant on rocky shores from which they had previously been absent. Therefore, although nutrient enrichment may benefit *Laminaria digitata*, the indirect effects of eutrophication, such as increased light attenuation from suspended solids in the water column and interference with the settlement and growth of germlings, may be detrimental. Increased nutrients may increase the abundance of ephemeral algae and result in smothering or changing the character of the biotope.

Habitat structure changes - removal of substratum (extraction)	Most of the species characteristic of this biotope are permanently attached to the substratum so would be removed upon substratum loss. These species are unable to re-attach and will be swept away so intolerance is assessed as high. The total population of *Polydora ciliata* is unlikely to be lost because it can reburrow into any remaining suitable substratum. Species diversity will be significantly reduced because many of the microhabitats provided by the characterizing species will be lost. Recovery of the main characterizing species *Laminaria digitata* is rapid with cleared rocks fully recolonized within two years (Kain, 1979). Most other characterizing species have a planktonic larva and/or are mobile and so can migrate into the affected area. Colonization of most species of fauna inhabiting kelp holdfast fauna in Norway were found as early as one year after kelp trawling (Christie et al., 1998) and on rocks the more diverse community of coralline algae joined by species of cnidarians, bryozoans and sponges seen on undredged plots was absent three years after kelp trawling (Birkett et al., 1998 b). However, although full species richness and abundance may be reduced the appearance of the biotope will be much as before substratum loss and so recovery is high.
Heavy abrasion, primarily at the seabed surface	The fronds of *Laminaria digitata* are leathery and the whole plant is very flexible so physical disturbance by a scallop dredge or an anchor landing on or being dragged across the seabed, is unlikely to cause significant damage to the kelp bed as a whole. However, some plants may be fatally damaged or ripped off the substratum. Other algae and sessile species such as sponges and large solitary tunicates are likely to be sensitive to abrasion and so the biotope as a whole has been assessed as having intermediate intolerance.
Light abrasion at the surface only	
Siltation rate changes	Some species, especially adult *Laminaria digitata* plants, are likely to protrude above any smothering material. The burrowing species such as *Pholas dactylus* and *Polydora ciliata* are able to tolerate high levels of smothering and sedimentation. However, others species such as the active suspension feeders and foliose algae are likely to be killed by smothering. Smothering can also be highly detrimental to kelp plants, in particular spores, gametophytes and young plants (Dayton, 1985) which will reduce the kelp population within the biotope and so intolerance has been assessed as intermediate. Species diversity within the biotope is likely to experience a major decline. Recovery is high because most characterizing species have a planktonic larva and/or are mobile and so can migrate into the affected area.
	Laminaria digitata can be found in areas of siltation although in very high silt environments the species may be out-competed by *Saccharina latissima*. Since many of the species, *Pholas dactylus* and *Polydora ciliata* in particular, in this biotope live in areas of high silt content (turbid water) it is expected that they would survive increased levels of silt in the water. However, very high levels of silt may clog respiratory and feeding organs of some suspension feeders such as sea squirts and may result in a decline in faunal species diversity. Increased siltation is unlikely to have a significant effect in terms of smothering by settlement in the regime of strong water flow typical of this biotope. A significant decrease in siltation levels may reduce food input to the biotope resulting in reduced growth and fecundity.
Visual disturbance	Macrophytes have no known visual sensors. Most macro invertebrates have poor or short range perception and although some are likely to respond to shading caused by predators the biotope as a whole is unlikely to be sensitive

	to visual disturbance.
Introduction or spread of non-indigenous species.	There is very little information available on microbial pathogens infecting the characterizing species of the biotope. However the occurrence of hyperplasia or gall growths, seen as dark spots, on *Laminaria digitata* is well known and may be associated with the presence of endophytic brown filamentous algae. Fronds of *Palmaria palmata* frequently bear algal epiphytes and endophytes, a number of marine fungi and galls produced by nematodes, copepods and bacteria. Growth rates of algae may be impaired by such infections. However, no evidence of losses of this biotope due to disease was found and it is likely that microbial pathogens will have only a minor possible impact on this biotope.
Introduction of microbial pathogens	The biotope occurs in areas where still water conditions do not occur and so some species may be intolerant of hypoxia. Cole et al. (1999) suggest possible adverse effects on marine species below 4 mg/l and probable adverse effects below 2mg/l. For instance, death of a bloom of the phytoplankton *Gyrodinium aureolum* in Mounts Bay, Penzance in 1978 produced a layer of brown slime on the sea bottom. This resulted in the death of fish and invertebrates presumably due to anoxia caused by the decay of the dead dinoflagellates (Griffiths et al., 1979). Kinne (1972) reports that reduced oxygen concentrations inhibit both algal photosynthesis and respiration. However, on return to oxygenated conditions, rapid recovery is likely. The main characterizing species, *Laminaria digitata*, colonizes cleared areas of the substratum within two years (Kain, 1975) and most other characterizing species have a planktonic larva and/or are mobile and so can migrate into the affected area.
Removal of target habitat	The non-native species currently (October 2000) most likely to colonize this biotope are the Northwest Pacific kelp *Undaria pinnatifida* and the Japanese brown algae *Sargassum muticum*. *Undaria pinnatifida*, which has been introduced into south-west Britain in recent years, may cause displacement of native kelps including *Laminaria digitata* although in Brittany only areas inhabited by *Saccorhiza polyschides* have been affected. *Sargassum muticum* which is generally considered to be a 'gap-filler' has not been documented to directly displace *Laminaria digitata* but in France it has replaced *Saccharina latissima* (studied as *Laminaria saccharina*) through over-growing and shading of underlying species (Eno et al., 1997). The American piddock *Petricola pholadiformis* has become established along south and east coasts of England from Lyme Regis in Dorset to the Humber although there is no documentary evidence that the species has displaced any native piddocks (Eno et al., 1997).

Removal of non-target habitat	Extraction of *Laminaria digitata* does occur although there is no evidence available on the effects of *Laminaria digitata* harvesting on the biodiversity of kelp bed species. However, since the whole plant, including the hold fast is removed it is likely that faunal diversity will show a major decline. Given that MIR.Ldig.Pid occurs in the sublittoral fringe it is unlikely that vast amounts of *Laminaria digitata* will be collected although an intermediate intolerance has been suggested to reflect some loss. *Palmaria palmata* is used as a vegetable substitute or animal fodder although harvesting on a commercial scale only takes place in France. Recovery should be high because recolonization by *Laminaria digitata* on cleared rocks takes place within 2 years (Kain, 1979) and most other characterizing species have planktonic larvae and/or are mobile and so can migrate into the affected area. However, partially due to human collection for food, piddocks are no longer prevalent across the entire Meditterranean and the Atlantic coast of Europe, where they were once found (Michelson, 1978). They now have a reduced distribution.

2.15	Maerl IGS.L.gla
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	*Lithothamnion glaciale* is a northern species so may be intolerant of increases in temperature. Adey (1970) found optimal growth rates at between 10-12°C. Development of reproductive conceptacles in *Lithothamnion glaciale* requires winter temperatures of between 1-5°C (Adey, 1970). Long term chronic increases in temperature may prevent sexual or asexual reproduction from occurring. Other species selected as being representative of the intolerance of the biotope (*Psammechinus miliaris* and *Ophiothrix fragilis*) also have intermediate intolerance to short term acute changes in temperature. Little information is available regarding sexual and asexual recruitment mechanisms in *Lithothamnion glaciale*. Vegetative propagation by growth and division of unattached maerl thalli is very slow and likely to take a considerable time.
Salinity changes - local increase	Unlike *Lithothamnion corallioides* and *Phymatolithon calcareum*, *Lithothamnion glaciale* is tolerant to some variation in salinity. The biotope is found at the head of sea lochs on the west coast of Scotland where riverine in-put and precipitation run-off cause variable salinity. Growth rates are decreased by reduced salinity (Adey, 1970).
Water flow (tidal current) changes - local increase	*Lithothamnion glaciale* is the key structural species within the biotope and is intermediately intolerant of decreases in water flow rate. *Lithothamnion glaciale* has a low recoverability from changes in water flow rate. Many of the species in this biotope live within the structure provided by the maerl nodules, where there is protection from changes in water flow rate. Little information is available regarding sexual and asexual recruitment mechanisms in *Lithothamnion glaciale*. Vegetative propagation by growth and division of unattached maerl thalli is very slow and likely to take a considerable time.
Emergence regime changes - local increase	Maerl species such as *Lithothamnion glaciale* are highly intolerant of desiccation, a consequence of emersion (Birkett et al., 1998). As the key structural species within the biotope, loss of this species will mean the biotope ceases to exist. Recoverability of *Lithothamnion glaciale* from total loss is very low. Although some species associated with this biotope are also found in the intertidal, live maerl beds are entirely sub-tidal (with one exception, Birkett et al., (1998)). Species in sub-tidal biotopes will tend to be intolerant of emergence. See additional information below for recovery
Wave exposure changes - local increase	Maerl beds with loose-lying nodules are restricted to less wave exposed areas (e.g. sea lochs for *Lithothamnion glaciale* beds). Some wave action may be beneficial in creating the 'streaming water' flow that this biotope requires. Strong wave action can break up the nodules into smaller pieces and scatter them from the maerl bed. Wave action during storms can be very important in determining the loss rates of thalli from maerl beds (Birkett et al., 1998). Little information is available regarding sexual and asexual recruitment mechanisms in *Lithothamnion glaciale*. Vegetative propagation by growth and division of unattached maerl thalli is very slow and likely to take a considerable time.

Water clarity decrease	Depth distribution of photosynthesising coralline algae is strongly affected by available light. The low clarity of coastal waters of the British Isles restricts the distribution of maerl beds to shallow waters - typically less than 10 m but occasionally down to around 30 m. An increase in turbidity would reduce photosynthesis but is unlikely to result in mortality, the maerl regaining photosynthetic vigour immediately after water clarity returned to previous conditions. Decreases in turbidity would facilitate photosynthesis and benefit the biotope. Faunal species tend to be less directly intolerant of changes in water clarity although reductions in light penetration may restrict the amount of food (phytoplankton) available to suspension feeders such as *Ophiothrix fragilis*. See additional information for recovery.
Habitat structure changes - removal of substratum (extraction)	*Lithothamnion glaciale* is the key structural species within the biotope and is highly intolerant of substratum loss. The selected important, functional or characterizing species in the biotope such as (*Ophiothrix fragilis*, *Psammechinus miliaris* and *Hyas araneus*) are also likely to be highly intolerant of substratum loss, as will the many abundant but less obvious infaunal species. *Lithothamnion glaciale* has a very low recoverability from substratum loss. Without this species the biotope would not exist. The species selected as representative of biotope intolerance (e.g. *Ophiothrix fragilis*, *Psammechinus miliaris*) are likely to return within a few years given the presence of a suitable substratum. Loss of the substratum as well as the structural, functional and characterizing species in the biotope will result in a major decline in species richness for the biotope. Little information is available regarding sexual and asexual recruitment mechanisms in *Lithothamnion glaciale*. J. Hall-Spencer (pers. comm.) has observed that colonization of new locations by maerl can be mediated by a 'rafting' process where maerl thalli are bound up with other sessile organisms that are displaced and carried by currents (e.g. *Saccharina latissima* (studied as *Laminaria saccharina*) holdfasts after storms). Growth and development of unattached maerl thalli from crustose individuals is very slow and likely to take a long time.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	Abrasion and physical disturbance may break up loose-lying maerl nodules or highly branching crustose plants into smaller pieces resulting in easier displacement by wave action. Abrasion may also disrupt the physical integrity of accreted maerl beds. Boat moorings and dragging anchor chains have been noted to damage the surface of maerl beds, as has demersal fishing gear (BIOMAERL team, 1999). Hall-Spencer & Moore (2000a, c) reported that a single pass of a scallop dredge could bury and kill 70% of the living maerl (usually found at the surface), redistributed coarse sediment and affected the associated community. Dredge tracks remained visible for 2.5 years. Hall-Spencer & Moore (2000a, c) suggested that repeated anchorage could create impacts similar to towed fishing gear. Overall, Hall-Spencer & Moore (2000a, c) concluded that maerl beds were particularly vulnerable to damage from scallop dredging activities. Other species in the biotope, including those selected as being representative of the sensitivity of the biotope also have intermediate intolerance to abrasion (e.g. the brittle test of *Psammechinus miliaris* and the fragile arms of *Ophiothrix fragilis* are easily damaged by impact). Many of the species in the biotope live buried within the maerl bed and will receive some protection from abrasion. However, megafauna on or in the top 10 cm of maerl were either removed or damaged and left on the dredge tracks, susceptible to subsequent predation (Hall-Spencer & Moore, 2000a). For example; crabs, Ensis species, the bivalve *Laevicardium crassum*, and sea urchins. Deep burrowing species such as the sea anemone *Cerianthus lloydii* and the crustacean

	Upogebia deltaura were protected by depth, although torn tubes of *Cerianthus lloydii* were present in the scallop dredge tracks (Hall-Spencer & Moore, 2000a). Hall-Spencer & Moore, (2000a) reported that sessile epifauna such as *Modiolus modiolus* or *Limaria hians*, sponges and the anemone *Metridium senile* where present, were significantly reduced in abundance in dredged areas for 4 years post-dredging. Overall, an intolerance of high has been recorded. See additional information for recovery.
Siltation rate changes	*Lithothamnion glaciale* is the key structural species within the biotope and is highly intolerant of smothering. The selected important, functional or characterizing species in the biotope such as *Ophiothrix fragilis*, *Psammechinus miliaris* and *Hyas araneus* are also likely to be highly intolerant of smothering as will the many, abundant but less obvious infaunal species. *Lithothamnion glaciale* has a very low recoverability from smothering. Without this species the biotope would cease to exist and so intolerance is set to high. Loss of the substratum as well as the structural, functional and characterizing species in the biotope will result in a major decline in species richness for the biotope.
	Lithothamnion glaciale is the key structural species within the biotope and is likely to be intolerant of increases in suspended sediment due to restriction of photosynthesis (Birkett et al., 1998) - see section on turbidity below. Recoverability for this key structural species is recorded as very low. Many of the species in this biotope live between the maerl nodules. Some of these species may benefit by increases in siltation (e.g. suspension feeders, species that use particles in construction (e.g. *Lanice conchilega*) whilst others will decline due to subsequent changes in granulometry of the habitat. Decreases in siltation may have the reverse effects.
Introduction or spread of non-indigenous species.	No diseases of European maerl species are known. However, the bacterial pathogen 'coralline lethal orange disease' from the Pacific is highly virulent (Littler & Littler, 1985). If this species was introduced to the region then maerl beds could potentially be significantly affected.
Introduction of microbial pathogens	Anoxia will kill live maerl (Jason Hall-Spencer, pers. comm.) but reduced oxygen levels for a week are unlikely to kill the algal nodules. Respiration, growth and reproduction may be affected by hypoxia. The loose structure of the maerl bed allows oxygenation to occur to considerable depth and this fact is exploited by many burrowing species. Changes in oxygenation are likely to cause a major decline in species richness.
Removal of target habitat	The introduced species *Crepidula fornicata* has radically altered the ecology of maerl beds in the Rade de Brest, France through increasing siltation and provision of substrata (J. Hall-Spencer pers. comm.). If this alien species was to extend its distribution to overlap with *Lithothamnion glaciale* maerl beds, similar alterations may occur.
Removal of non-target habitat	Maerl beds, of which *Lithothamnion glaciale* can form an important component, particularly in Scotland, may be subject to exploitation (Flora Celtica Database, 2000). Harvesting of maerl beds is one of the greatest threats. In England only dead maerl is extracted. However, even this can have detrimental effects, resuspending sediments that resettle and cover the algae reducing photosynthesis. In live beds the living nodules are typically on the surface so these are the first to be removed. *Lithothamnion glaciale* can also be adversely affected indirectly through the removal of other species. Extraction of other organisms such as scallops using dredges can cause great damage through

	physical disruption, crushing, burial and the loss of stabilizing algae (Hall-Spencer & Moore, 2000(a)). Other large burrowing bivalves such as Ensis sp. and Venerupis sp. are harvested using suction dredging which causes structural damage and resuspends sediment that resettles, covering the algae and reducing photosynthesis (Hall-Spencer & Moore, 2000(a)). These effects are best addressed using the relevant physical factors (see Physical Disturbance) but overall, intolerance has been assessed as high. Recovery is expected to be very low (see additional information).

2.15	**Maerl IGS.Phy.HEC**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	*Phymatolithon calcareum* is the key structural species within the biotope and is intermediately intolerant of changes in temperature This maerl species dies below 2 degrees C and above 22 degrees C. *Neopentadactyla mixta*, a species that has been chosen as representative of the intolerance of the echinoderms in the biotope (although not necessarily always present itself), is also intermediately intolerant. *Phymatolithon calcareum* has a moderate recoverability from changes in temperature. This biotope potentially contains a wide variety of species, only some of which will be intolerant of changes in temperature.
Salinity changes - local increase	The key structural species, *Phymatolithon calcareum*, has a high intolerance to decreases in salinity (King & Schramm, 1976). *Neopentadactyla mixta*, a species selected as being representative of the intolerance of echinoderms in the biotope (although not necessarily always present itself) is also highly intolerant of decreases in salinity (Smith 1983). *Phymatolithon calcareum* has a very low recoverability from changes in salinity. This biotope is found deeper than shallow waters where salinity reductions from freshwater run-off occur. The biotope occurs in the more open parts of inlets where open coast salinity waters prevail. Changes from full salinity will probably cause a major decline in species richness.
Water flow (tidal current) changes - local increase	*Phymatolithon calcareum* is the key structural species within the biotope and is intermediately intolerant of decreases in water flow rate. *Neopentadactyla mixta*, a species that has been chosen as representative of the intolerance of the echinoderms in the biotope (although not necessarily always present itself), is highly intolerant of changes in water flow rate. *Phymatolithon calcareum* has a moderate recoverability from changes in water flow rate. Many of the species in this biotope live within the structure provided by *Phymatolithon calcareum*, where there is protection from changes in water flow rate.
Emergence regime changes - local increase	*Phymatolithon calcareum* is the key structural species within the biotope and is highly intolerant of changes in emergence regime. *Phymatolithon calcareum* has a very low recoverability from changes in emergence regime.

Wave exposure changes - local increase	*Phymatolithon calcareum* is the key structural species within the biotope and is likely to be intermediately intolerant of changes in wave exposure. Strong wave action can cause live maerl thalli to be buried, broken into smaller pieces or dispersed. *Neopentadactyla mixta*, a species that has been chosen as representative of the intolerance of the echinoderms in the biotope (although not necessarily always present itself), is highly intolerant of changes in wave exposure. Both *Phymatolithon calcareum* and *Neopentadactyla mixta* have moderate recoverability from changes in wave exposure. Maerl biotopes can be highly mobile making it difficult for many species to establish themselves, increases in wave exposure may increase this mobility.
Water clarity decrease	*Phymatolithon calcareum* is the key structural species within the biotope and is intermediately intolerant of changes in turbidity. Being photosynthetic, this species is reliant on light availability. Consequently, increases in turbidity drastically reduce the lower depth limits of this species. It occurs to 105 m depth off Malta, to 32 m depth off western Ireland and to 18 m in the Clyde. *Phymatolithon calcareum* has a moderate recoverability from changes in turbidity. This biotope contains fewer algal species than other maerl biotopes. Faunal species tend to be less intolerant of changes in water clarity.
Non-synthetic compound contamination (incl. heavy metals)	Insufficient information is available about the key and important species in this biotope to be able to make an assessment of intolerance to heavy metal contamination.
Habitat structure changes - removal of substratum (extraction)	*Phymatolithon calcareum* is the key structural species within the biotope and is highly intolerant of substratum loss. Other obvious characterizing species in the biotope such as (*Neopentadactyla mixta* and *Nemertesia ramosa*) are also likely to be highly intolerant of substratum loss as will the more abundant but less obvious infaunal species. *Phymatolithon calcareum* has a very low recoverability from substratum loss. Loss of the substratum as well as the structural and characterizing species in the biotope will probably result in a major decline in species richness for the area.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	In experimental studies, Hall-Spencer & Moore (2000a, c) reported that the passage of a single scallop dredge through a maerl bed could bury and kill 70% of living maerl in its path. The passing dredge also re-suspended sand and silt that settled over a wide area (up to 15 m from the dredged track), and smothered the living maerl. Evidence from historic specimens of *Phymatolithon calcareum* collected between 1885 and 1891, before the onset of scallop fishing, showed that specimens collected from a scallop dredged area were smaller than those collected in the late 19th century (Hall-Spencer & Moore, 2000a, c). Abrasion may break up maerl nodules into smaller pieces resulting in easier displacement by wave action. Abrasion may also disrupt the physical integrity of accreted maerl beds. The dredge left a ca 2.5 m track and damaged or removed most megafauna within the top 10 cm of maerl. The tracks remained visible for up to 2.5 years. In pristine beds experimental scallop dredging reduced the population densities of epibenthic species for over 4 years, while the maerl species themselves may take decades to recover. In previously dredged maerl beds, the benthic communities recovered in 1-2 years . Maerl habitats are dependant on survival of slow-growing algae e.g. *Phymatolithon calcareum* and other maerl species, which cannot withstand prolonged burial, due to the lack of light, and die (Hall-Spencer & Moore, 2000a, c). Hall-Spencer & Moore, (2000a, c) concluded that maerl beds were

	particularly sensitive to the impacts of towed fishing gears. Boat moorings and dragging anchor chains have been noted to damage the surface of maerl beds, as has demersal fishing gear. Therefore, intolerance has been assessed as high. However, megafauna on or in the top 10 cm of maerl were either removed or damaged and left on the dredge tracks, susceptible to subsequent predation (Hall-Spencer & Moore, 2000a). For example; crabs, Ensis species, the bivalve *Laevicardium crassum*, and sea urchins. Deep burrowing species such as the sea anemone *Cerianthus lloydii* and the crustacean *Upogebia deltaura* were protected by depth, although torn tubes of *Cerianthus lloydii* were present in the scallop dredge tracks (Hall-Spencer & Moore, 2000a). *Neopentadactyla mixta* may also escape damage due to the depth of its burrow, especially during winter torpor. Hall-Spencer & Moore, (2000a) reported that sessile epifauna or shallow infauna such as *Modiolus modiolus* or *Limaria hians*, sponges and the anemone *Metridium senile* where present, were significantly reduced in abundance in dredged areas for 4 years post-dredging. Other epifaunal species, such as hydroids (e.g. Nemertesia species) and red seaweeds are likely to be removed by a passing dredge. Overall, the key structural species, *Phymatolithon calcareum*, is recorded as being highly intolerant of physical disturbance, and an overall biotope intolerance of high has been recorded. Propagation of *Phymatolithon calcareum* in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Phymatolithon calcareum* means that vegetative regeneration will take a long time. Therefore, recoverability has been assessed as very low.
Siltation rate changes	*Phymatolithon calcareum* is the key structural species within the biotope and is highly intolerant of smothering. Scallop dredging is one of the main causes of smothering in maerl beds. A single passage of a dredge may bury and kill 70 percent of living maerl in their path. *Phymatolithon calcareum* has a very low recoverability from smothering. The loose and complex consistency of this biotope provides considerable structural diversity utilized by a wide range of species. Smothering of the main structural species, *Phymatolithon calcareum*, will probably result in a major decline in species richness for the area.
	Phymatolithon calcareum is the key structural species within the biotope and is highly intolerant of changes in siltation. *Phymatolithon calcareum* has a very low recoverability from changes in siltation. Many of the species in this biotope live between the maerl nodules. Some of these species will benefit whilst others will decline due to changes in siltation and subsequent changes in granulometry of the habitat.
Underwater noise changes	*Neopentadactyla mixta*, a species that has been chosen as representative of the intolerance of the echinoderms in the biotope (although not necessarily always present itself), shows low intolerance to disturbance by noise. Few benthic species are highly intolerant of noise disturbance.
Visual disturbance	None of the key or important species in this biotope are sensitive to visual disturbance. It is unlikely that any of the infaunal and epifaunal species associated with this biotope are sensitive to visual disturbance.
Introduction or spread of non-indigenous species.	The key structural species of this biotope (*Phymatolithon calcareum*) has intermediate intolerance to the introduction of microbial pathogens. This refers to the potential effects of the western pacific disease 'coralline lethal orange disease'. *Phymatolithon calcareum* has a moderate recoverability from disease. This disease is specific to coralline algae and will not affect other

	taxa.
Introduction of microbial pathogens	The important characterizing species *Nemertesia ramosa* is intermediately intolerant of and has a high recoverability from changes in oxygenation. Anoxia will kill live maerl (J. Hall-Spencer, pers. comm.). The loose structure of the maerl bed allows oxygenation to occur to considerable depth and this fact is exploited by many burrowing species. Changes in oxygenation are likely to cause a major decline in species richness.
Removal of target habitat	The introduced species *Crepidula fornicata* has radically altered the ecology of maerl beds in the Rade de Brest, France through increasing siltation and provision of substrata (J. Hall-Spencer pers. comm.).
Removal of non-target habitat	*Phymatolithon calcareum*, the only key structuring species for the biotope, is subject to commercial extraction although it is highly unlikely that either of the important characterizing species (*Nemertesia ramosa* or *Neopentadactyla mixta*) would be. The actual removal of *Phymatolithon calcareum* (usually by dredging) would also result in the removal of many other species associated with the biotope. Maerl beds are dredged to extract scallops and other molluscs which causes considerable structural damage. Dredging causes loss of sessile species such as *Limaria hians* and *Modiolus modiolus* and this can alter the stability and structural properties of the bed (Hall-Spencer & Moore, 2000(a)). These two species support their own suite of encrusting and epilithic species which will also be lost (see Physical Disturbance for further details). *Limaria hians* remains at significantly reduced levels for at least 4 years so recoverability will be moderate or worse (Hall-Spencer & Moore, 2000(a)). In experimental studies, Hall-Spencer & Moore (2000a, c) reported that the passage of a single scallop dredge through a maerl bed could bury and kill 70% of living maerl in its path. The passing dredge also re-suspended sand and silt that settled over a wide area (up to 15 m from the dredged track), and smothered the living maerl. Evidence from historic specimens of *Phymatolithon calcareum* collected between 1885 and 1891, before the onset of scallop fishing, showed that specimens collected from a scallop dredged area were smaller than those collected in the late 19th century (Hall-Spencer & Moore, 2000a, c). The dredging may break up maerl nodules into smaller pieces resulting in easier displacement by wave action. Furthermore, the physical integrity of accreted maerl beds may be disrupted. The dredge left a ca 2.5 m track and damaged or removed most megafauna within the top 10 cm of maerl. The tracks remained visible for up to 2.5 years. In pristine beds experimental scallop dredging reduced the population densities of epibenthic species for over 4 years, while the maerl species themselves may take decades to recover. In previously dredged maerl beds, the benthic communities recovered in 1-2 years. Maerl habitats are dependant on survival of slow-growing algae e.g. *Phymatolithon calcareum* and other maerl species, which cannot withstand prolonged burial, due to the lack of light, and die (Hall-Spencer & Moore, 2000a, c). Hall-Spencer & Moore, (2000a, c) concluded that maerl beds were particularly sensitive to the impacts of towed fishing gears and, therefore, intolerance has been assessed as high. Propagation of *Phymatolithon calcareum* in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Phymatolithon calcareum* means that vegetative regeneration will take a long time. Therefore, recoverability has been assessed as very low.

2.16	**Mud habitats deep water: MCR.ModT**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	*Modiolus modiolus* is a boreal species reaching its southern limit in British waters (Holt et al., 1998). Davenport & Kjørsvik (1982) suggested that its inability to tolerate temperature change was a factor preventing the horse mussel from colonizing the intertidal in the UK. Intertidal specimens were more common on northern Norwegian shores (Davenport & Kjørsvik, 1982). Little information on temperature tolerance in *Modiolus modiolus* was found, however, it s upper lethal temperature is lower than that for *Mytilus edulis* (Bayne et al., 1976) by about 4°C (Henderson, 1929; cited in Davenport & Kjørsvik, 1982). Subtidal populations are protected from major, short term changes in temperature by their depth. However, Holt et al. (1998) suggested that because *Modiolus modiolus* reaches its southern limit in British waters it may be susceptible to long term increases in summer water temperatures. Therefore, the absence of this species from the intertidal in the UK (with a few exceptions) suggests that it is intolerant of temperature change. The suggested susceptibility to long-term summer temperature rise could result in a reduction in the extent of the UK population and its associated community. Lower infralittoral to circalittoral populations are exposed to a narrow range of temperatures when compared to the intertidal or even the shallow subtidal. Deep water species are therefore, likely to be intolerant of temperature change, especially short term acute change. For example, eight deep water red algae species had lower upper lethal temperatures than three shallow water red algae (Kain & Norton, 1990). *Delesseria sanguinea* is tolerant of 23°C for a week (Lüning, 1984) but dies rapidly at 25°C. North Sea and Baltic specimens grew between 0-20°C, survived at 23°C but died rapidly at 25°C (Rietema, 1993). Rietema (1993) reported temperature differences in temperature tolerance between North Sea and Baltic specimens. Lüning (1990) reports optimal growth in *Delesseria sanguinea* between 10 - 15°C and optimal photosynthesis at 20°C. However, the upper limit of temperature tolerance in red algae reduced by lowered salinity (Kain & Norton, 1990). Temperature is a critical factor in stimulating or preventing hydroid reproduction and most species exhibit an optimal range (Gili & Hughes, 1995). Bishop (1985) noted that gametogenesis in *Echinus esculentus* proceeded at temperatures between 11 - 19°C although continued exposure to 19°C destroyed synchronicity of gametogenesis between individuals. Bishop (1985) suggested that this species cannot tolerate high temperatures for prolonged periods due to increased respiration rate and resultant metabolic stress, suggesting intolerance to acute temperature change. However, *Echinus esculentus* is recorded from southern and northern British Isles suggesting tolerance of the temperature range found in the UK. Short term acute changes in temperature are noted to cause a reduction in the loading of subcutaneous symbiotic bacteria in echinoderms such as *Ophiothrix fragilis*. Reductions in these bacteria are probably indicative of levels of stress and may lead to mortality (Newton & McKenzie, 1995). However, the distribution of *Ophiothrix fragilis* is large, ranging from northern Norway south to the Cape of Good Hope. Consequently this species is exposed to temperatures both above and

	below those found in the British Isles. Overall, therefore, it is likely that a proportion of the horse mussel population and the associated community may be lost due to acute temperature change (see benchmark). Long term increases in temperature may reduce the populations range in the UK. Therefore, an intolerance of intermediate has been recorded. While, several members of the community are likely to recover within a few years, horse mussel recruitment is sporadic, varies with season, annually and with location and hydrographic regime and is generally low, therefore it may take many years for a population to recover from damage and a recoverability of low (10-25 years) has been recorded.
Temperature changes - local decrease	*Modiolus modiolus* is a boreal species reaching its southern limit in British waters (Holt et al., 1998). Lower infralittoral to circalittoral populations are exposed to a narrow range of temperatures when compared to the intertidal or even the shallow subtidal. Deep water species are therefore, likely to be intolerant of temperature change, especially short term acute change. Long term decreases in temperature could allow Modiolus beds and, therefore, the biotope to extend its range southwards. Other members of the community have a wide distribution in the north east Atlantic, although hydroids may be affected by decreased temperatures, especially short term acute changes. However, the biotope could potentially extend its range due to a decrease in temperature and 'not sensitive*' has been recorded. Short term acute change may remove members of the epifaunal community and a minor decline in species richness may result.
Salinity changes - local increase	This biotope (MCR.ModT) and those biotopes in has been used to represent, are found from the lower infralittoral and the circalittoral and are unlikely to be exposed to anything but full salinity.
Water flow (tidal current) changes - local increase	MCR.ModT occurs in tide swept locations in moderately strong to strong tidal streams. An increase in water flow may interfere with feeding in *Modiolus modiolus* since in flume studies the inhalant siphon closed by about 20% in currents above 55 cm/sec (Wildish et al., 2000). Similarly, fouling of the horse mussels increases their intolerance to dislodgement by strong tidal streams (Witman, 1985). Comely (1978) suggested that areas exposed to strong currents required an increase in byssus production, at energetic cost, and resulted in lower growth rates. Therefore, an increase in water flow rates to very strong may result in loss of a proportion of the population, depending on the size of the beds, the level of fouling or the nature of the substratum. Horse mussel beds on coarse or hard substrata may be less intolerant than beds on mobile, fine sediments. Epifauna such as hydroids may be damaged, or their feeding prevented by strong water flow (Gili & Hughes, 1995). The characterizing hydroids may be replaced by hydroid species more tolerant of strong water flow such as *Tubularia indivisa*. Brittlestars such as *Ophiothrix fragilis* may be swept away by increased water flow, e.g. above a certain water speed (25 cm/s) the feeding arms are withdrawn from the water column (Warner & Woodley, 1975; Hiscock, 1983). At water speeds above about 28 cm/s individuals or even small groups may be displaced from the substratum and they have been observed being rolled along the seabed by the current (Warner, 1971). Living in dense aggregations may reduce displacement of brittlestars by strong currents (Warner & Woodley, 1975) and living within crevices in the horse mussel beds will presumably also provide some protection. Sea urchins, such as *Echinus esculentus*, are known to be swept away by strong currents and, although not killed, may be removed from the

	community and unable to return until water flow rates return to prior conditions. Overall, therefore a proportion of the horse mussel population may be removed, together with several members of the community and an intolerance of intermediate has been recorded. The biotopes SCR.ModCvar and SCR.ModHAs may be more intolerant of dislodgement due to there muddy substratum. The associated community will probably change from species tolerant of siltation and low water flow to species tolerant of higher water flow, perhaps coming to resemble MCR.ModT. Horse mussel recruitment is sporadic, highly variable and some areas receive little or no recruitment for several years (see additional information below). Therefore, a recoverability of low has been recorded.
Water flow (tidal current) changes - local decrease	Flume experiments suggested that Modiolus sp. can deplete the seston directly over dense beds when water flow is low, resulting in a reduction in the density of the mussel bed (Wildish & Kristmanson, 1984, 1985: Holt et al., 1998). *Alcyonium digitatum* prefers areas of high water flow, and its abundance may decline in reduced water flow. Brittlestars such as *Ophiothrix fragilis* are passive suspension feeders and require water flow to supply them with food particles. A reduction in water flow may reduce food availability, however *Ophiothrix fragilis* can survive considerable loss of body mass during reproductive periods (Davoult et al., 1990) so restricted feeding may be tolerated, and this species is found in sheltered areas of reduced water flow. Hydroids and bryozoans also require water flow to provide them with food particles but hydroid species in deeper water, with generally less water movement, have higher biomass, are larger and longer-lived than in shallower waters. Therefore, a reduction in water flow may reduce the density of the horse mussel bed, and may change the associated community favouring species that prefer low water flow. The biotope MCR. ModT may come to resemble the sheltered horse mussel beds (SCR.ModCvar or SCR.ModHAs). In addition, in the sheltered biotopes decreased water flow will increase the risk of deoxygenated conditions (see below). Overall, therefore, an intolerance of intermediate has been recorded. Horse mussel recruitment is sporadic, highly variable and some areas receive little or no recruitment for several years (see additional information below). Therefore, a recoverability of low has been recorded.
Emergence regime changes - local increase	Most of the species identified as indicative of intolerance may be of 'intermediate' or 'high' intolerance to desiccation and emergence regime, including *Modiolus modiolus*. Hydroids especially are also likely to be highly intolerant. However, this biotope (MCR.ModT) and those biotopes it has been used to represent, is found from the lower infralittoral and the circalittoral and in unlikely to be exposed to the air.
Emergence regime changes - local decrease	Decreased emersion is unlikely to adversely affect this biotope (or those it has been chosen to represent) and may allow members of the biotope to feed longer and improve condition, i.e. the biotope may benefit. The biotope could possibly extend its range, although the rates of increase in bed size are likely to be slow, probably longer than the benchmark level.

Wave exposure changes - local increase	An increase in wave exposure may result in increased oscillatory movement at the seabed, which can be a destructive force (Hiscock, 1983). Comely (1978) suggested that in areas of strong water flow horse mussels increased byssus production. *Mytilus edulis* was shown to increase byssus production in response to agitation (Young, 1985) and *Modiolus modiolus* may respond similarly, so that increased wave action may be resisted. Populations on mobile sediment may be removed by strong wave action due to removal or changes in the substratum. No information concerning storm damage was found. Epifauna such as hydroids may be damaged, or their feeding prevented by strong water flow (Gili & Hughes, 1995). The characterizing hydroids may be replaced by hydroid species more tolerant of strong water flow such as *Tubularia indivisa*. Brittlestars such as *Ophiothrix fragilis* may be swept away by increased water flow, e.g. above a certain water speed (25 cm/s) the feeding arms are withdrawn from the water column (Warner & Woodley, 1975; Hiscock, 1983). At water speeds above about 28 cm/s individuals or even small groups may be displaced from the substratum and they have been observed being rolled along the seabed by the current (Warner, 1971). Living in dense aggregations may reduce displacement of brittlestars by strong currents (Warner & Woodley, 1975) and living within crevices in the horse mussel beds will presumably also provide some protection. Sea urchins, such as *Echinus esculentus*, are known to be swept away by strong currents and, although not killed, may be removed from the community and unable to return until calmer conditions return. Overall, therefore a proportion of the horse mussel population may be removed, together with several members of the community and an intolerance of intermediate has been recorded. The biotopes SCR.ModCvar and SCR.ModHAs may be more intolerant of dislodgement due to their muddy substratum. The associated community will probably change from species tolerant of siltation and low water low to species tolerant of higher water flow, perhaps coming to resemble MCR.ModT. Horse mussel recruitment is sporadic, highly variable and some areas receive little or no recruitment for several years (see additional information below). Therefore, a recoverability of low has been recorded.
Wave exposure changes - local decrease	Tidal flow rather than wave action is the predominant force in feeding, so that wave action is most important in relation to the potential destruction of beds. Providing that tidal flows remains reasonably strong, horse mussel beds may benefit from a reduction in wave action and a rank of 'not sensitive*' is suggested. Decreased wave action may allow horse mussel beds to extend into shallower depths, however, the rates of increase in bed size are likely to be slow, probably much longer than the benchmark level.

Water clarity increase	*Modiolus modiolus* is found in turbid to clear waters (Holt et al., 1998). Decreases in turbidity may increase phytoplankton productivity and therefore, potentially increase food availability for the horse mussels and other suspension feeding epifauna. Increased light availability will benefit red algae, promoting growth but may reduce the abundance of hydroids by interfering with settlement, or due to competition for space with red algae (Kain & Norton, 1990; Gili & Hughes, 1995). Red algae may increase in abundance. Increased growth of algae, especially kelps, may increase the horse mussel beds vulnerability to dislodgement by strong water flow, depending on the level of grazing by sea urchins in particular (Witman, 1985). Therefore, increased fouling is likely to impair feeding and hence reproduction in horse mussels and an intolerance of low has been recorded. However, in the absence of sufficient grazing, fouling by foliose algae, especially kelps may result in dislodgement of a proportion of the mussel bed (Witman, 1985). Recovery will depend on reduction in red algae and colonization by other epifauna such as bryozoans or hydroids, which likely to be rapid, depending on local conditions and the proximity of adult colonies.
Water clarity decrease	*Modiolus modiolus* is found in turbid to clear waters (Holt et al., 1998). Increased turbidity may decrease phytoplankton primary productivity and hence the food supply for the horse mussel. However, Navarro & Thompson (1996) concluded that the horse mussel was adapted to an intermittent and often inadequate food supply. However, other suspension feeding species may be affected by the reduced food availability, e.g. *Ophiothrix fragilis*, however this species can survive loss of body mass during reproductive periods and is likely to survive reduced food availability. *Alcyonium digitatum* will be unaffected in the factor changes during its quiescent period (late July - December) and will probably survive during the rest of the year, although is reproductive capacity may be reduced. While encrusting coralline algae are particularly tolerant of low light conditions, increased turbidity is likely to adversely affect foliose red algae. Although shade tolerant, a decrease in light intensity, comparable to the benchmark level, is likely to reduce photosynthesis, reduce growth and affect reproduction. Increased turbidity is therefore likely to result in loss of red algae from this biotope. However, other epifauna may benefit as a result, e.g. hydroids may increase in abundance, size and diversity. Algal grazers such as gastropods and chitons may be lost from the biotope if no alternative food sources are available. Therefore, there will be losses for some species and gains for others and an intolerance of low has been recorded due to the intolerance of red algae within the biotope. Recoverability will depend on recolonization by red algae once turbidity returns to previous or tolerable levels e.g. *Delesseria sanguinea* was reported to recolonize cleared blocks within 56-59 days in one experiment and 41 weeks (8 months) in another depending on depth and spore availability (Kain, 1975). Therefore a recoverability of high has been recorded.
Non-synthetic compound contamination (incl. heavy metals)	*Modiolus modiolus* may exhibit tolerance to heavy metals similar to that of *Mytilus edulis*. The tissue distribution of Cd, Zn, Cu, Mg, Mn, Fe and Pb was examined in *Modiolus modiolus* by Julshamn & Andersen (1983) who reported the presence of Cd binding proteins but did not document any adverse affects. Richardson et al. (2001) examined the presence of Cu, Pb and Zn in the shells of *Modiolus modiolus* from a relatively un-contaminated site and from a site affected by sewage sludge dumping. The persistence of a population of horse mussels at the sewage sludge dumping site suggests that tolerance to heavy

	metal contamination levels at that site. Holt et al. (1998) reported that long-term changes in contaminant loads associated with spoil dumping were detectable in the shells of horse mussels in a bed off the Humber estuary. This observation showed survival of horse mussels in the vicinity of a spoil dumping ground but no information on their condition was available (Holt et al., 1998). Little information on the effects of heavy metal contamination of other members of the community was found. However, *Echinus esculentus* populations in the vicinity of an oil terminal in A Coruna Bay, Spain, showed developmental abnormalities in the skeleton. The tissues contained high levels of aliphatic hydrocarbons, naphthalenes, pesticides and heavy metals (Zn, Hg, Cd, Pb, and Cu) (Gomez & Miguez-Rodriguez, 1999). Bryan (1984) reported that early work had shown that echinoderm larvae were intolerant of heavy metals. However, it is unlikely that established sea urchins would be adversely affected and there is no evidence to suggest that mortality would occur in associated species in the biotope. Heavy metal contamination may affect the condition of species in the biotope and, therefore, an intolerance of low has been recorded. Recovery of the biotope will depend on depuration or detoxification of the heavy metals and recovery of condition, therefore a recovery of high has been reported.
Non-synthetic compound contamination (incl. hydrocarbons)	Horse mussel beds are protected from the direct effects of oil spills due to their subtidal habitat, although shallow subtidal populations will be more vulnerable. Horse mussel beds may still be affected by oil spills and associated dispersants where the water column is well mixed vertically, e.g. in areas of strong wave action. Oils may be ingested as droplets or adsorbed onto particulates. Hydrocarbons may be ingested or absorbed from particulates or in solution, especially PAHs. Suchanek (1993) noted that sub-lethal levels of oil or oil fractions reduce feeding rates, reduce respiration and hence growth, and may disrupt gametogenesis in bivalve molluscs. Widdows et al. (1995) noted that the accumulation of PAHs contributed to a reduced scope for growth in *Mytilus edulis*. Holt & Shalla (unpublished; cited in Holt et al., 1998) did not observe any visible affects on a population of *Modiolus modiolus* within 50m of the wellhead of a oil/gas exploration rig (using water based drilling muds) in the north east of the Isle of Man. Echinoderms tend to be very intolerant of various types of marine pollution (Newton & McKenzie, 1995). *Echinus esculentus* populations in the vicinity of an oil terminal in A Coruna Bay, Spain, showed developmental abnormalities in the skeleton. The tissues contained high levels of aliphatic hydrocarbons, naphthalenes, pesticides and heavy metals (Zn, Hg, Cd, Pb, and Cu) (Gomez & Miguez-Rodriguez 1999). The sub-cuticular bacteria that are symbiotic with *Ophiothrix fragilis* are reduced in number following exposure to hydrocarbons. Exposure to 30,000 ppm oil reduces the bacterial load by 50 % and brittle stars begin to die (Newton & McKenzie, 1995). However, there are no field observations of mortalities caused by exposure to hydrocarbons. Laboratory studies of the effects of oil and dispersants on several red algae species, including *Delesseria sanguinea* (Grandy 1984 cited in Holt et al. 1995) concluded that they were all sensitive to oil/ dispersant mixtures, with little differences between adults, sporelings, diploid or haploid life stages. O'Brien & Dixon (1976) suggested that red algae were the most sensitive group of algae to oil or dispersant contamination, possibly due to the susceptibility of phycoerythrins to destruction, and that the filamentous forms were the most sensitive. Therefore, is it possible that hydrocarbon contamination may reduce reproductive success and growth rates

	in horse mussel populations. Reduced scope for growth may be of particular importance in juveniles that are subject to intense predation pressure, resulting in fewer individuals reaching breeding age. However, May & Pearson (1995) reported that stations in the vicinity of ballast water diffuser, probably containing fresh petrogenic hydrocarbons, showed a consistently high diversity (since surveys started in 1978) and included patches of Modiolus sp. beds. The strong currents in the area probably flushed polluting materials away from the station, and hence reduced the stress on the population (May & Pearson, 1995). The persistence of a highly diverse community suggests low intolerance to hydrocarbon contaminated effluent. However, red algae are likely to be highly sensitive to hydrocarbon contamination (see benchmark), suggesting that while overall species richness and diversity may not be reduced significantly, some characterizing species may be lost, or their abundance reduced. Therefore, an overall biotope intolerance of intermediate has been recorded. Recovery would depend on growth of surviving epifauna, or re-colonization and would probably require up to 5 years (see additional information below).
Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	No information concerning the effects of synthetic contaminants on *Modiolus modiolus* was found. However, it is likely to have a similar metabolism to that of *Mytilus edulis* and hence, possibly, a similar tolerance to chemical contaminants. Livingstone & Pipe (1992) cite Palmork & Solbakken (1981) who reported that *Modiolus modiolus* accumulated poly-aromatic hydrocarbons (PAHs) and examined the depuration of phenanthrene from horse mussel tissue. However, no effects on the horse mussel were documented. PAHs contribute to a reduced scope for growth in *Mytilus edulis* (Widdows et al., 1995) and probably have a similar effect in the horse mussel but to an unknown degree. Tri butyl-tin (TBT) has been reported to affect bivalve molluscs as follows: reduced spat fall in *Pecten maximus*, *Musculus marmoratus* and *Limaria hians*; inhibition of growth in *Mytilus edulis* larvae, and inhibition of growth and metamorphosis in *Mercenaria mercenaria* larvae (Bryan & Gibbs, 1991). Therefore, it is likely that TBT may interfere with growth and settlement of *Modiolus modiolus* larvae. Horse mussel populations exhibit sporadic recruitment, therefore any factor that adversely affects recruitment will have an adverse effect on the population, although the effects may not be observed for some time since the species in so long lived. O'Brien & Dixon (1976) suggested that red algae were the most sensitive group of algae to oil or dispersant contamination, possibly due to the susceptibility of phycoerythrins to destruction, and that the filamentous forms were the most sensitive. However, most evidence relates to dispersants, e.g. heavy mortality of *Delesseria sanguinea* occurred down to 12 m after the Torrey Canyon oil spill (probably due to a mixture of wave action and dispersant application) (Smith, 1968). Laboratory studies of the effects of oil and dispersants on several red algae species, including *Delesseria sanguinea* (Grandy, 1984 cited in Holt et al., 1995) concluded that they were all sensitive to oil/ dispersant mixtures, with little differences between adults, sporelings, diploid or haploid life stages. Smith (1968) reported dead colonies of *Alcyonium digitatum* and dead *Echinus esculentus* at a depths of up to 16m in the locality of Sennen Cove (Pedu-men-du, Cornwall) resulting from the offshore spread and toxic effect of detergents e.g. BP 1002. Cole et al. (1999) suggested that herbicides, such as simazina and atrazine were very toxic to macrophytes. Hoare & Hiscock (1974) noted that *Delesseria sanguinea* was excluded from Amlwch

	Bay, Anglesey by acidified halogenated effluent discharge. In addition *Echinus esculentus* populations in the vicinity of an oil terminal in A Coruna Bay, Spain, showed developmental abnormalities in the skeleton. The tissues contained high levels of aliphatic hydrocarbons, naphthalenes, pesticides and heavy metals (Zn, Hg, Cd, Pb, and Cu) (Gomez & Miguez-Rodriguez, 1999). Loss of epifaunal grazers such as sea urchins may adversely affect the horse mussel population due to fouling. Therefore, evidence suggests that horse mussels are of intermediate intolerance to synthetic chemicals, however, given the additional high intolerance of *Echinus esculentus* and red algae an overall intolerance of high has been recorded albeit at low confidence. Horse mussel recruitment is sporadic, varies with season, annually and with location and hydrographic regime and is generally low, therefore it may take many years for a population to recover from damage and a recoverability of low (10 -25years) has been recorded.
Radionuclide contamination	Insufficient information.
De-oxygenation	Most of the species identified as indicative of intolerance may be of 'intermediate' or 'low' in tolerance to a reduction in salinity. Hydroids especially are also likely to be highly intolerant. This biotope (MCR.ModT) and those biotopes in has been used to represent, is found from the lower infralittoral and the circalittoral and would only be exposed to low salinity in exceptional circumstances. Nevertheless, after a winter and spring of extremely high rainfall, populations of *Modiolus modiolus* at the entrance to Loch Leven (near Fort William) were found dead, almost certainly due to low salinity outflow (K. Hiscock, pers. comm.). Therefore, an intolerance of high has been recorded. The epifaunal organisms such as anthozoans, hydroids, barnacles, ascidians and brittlestars are likely to take some time to recolonize but could potentially recover within five years. However, *Modiolus modiolus* beds, are likely to take considerable time the recolonize and to develop into a bed similar in size and in the diversity and species richness they support (see additional information below). Therefore, a recoverability of very low has been recorded.
Nutrient enrichment	Navarro & Thompson (1996) suggested that *Modiolus modiolus* was adapted to an intermittent and often inadequate food supply. The persistence of a horse mussel population in the vicinity of a sewage sludge dumping site (Richardson et al., 2001) suggests that the species is tolerant of high nutrient levels. Moderate nutrient enrichment may, therefore, be beneficial by increasing phytoplankton productivity and organic particulates, and hence food availability. However, eutrophication may have indirect adverse effects, such as increased turbidity, increased suspended sediment (see above), increased risk of deoxygenation (see below) and the risk of algal blooms. Shumway (1990) reviewed the effects of algal blooms on shellfish and reported that a bloom of *Gonyaulax tamarensis* (Protogonyaulax) was highly toxic to *Modiolus modiolus*. Shumway (1990) also noted that both Mytilus spp. and Modiolus spp. accumulated paralytic shellfish poisoning (PSP) toxins faster than most other species of shellfish, e.g. horse mussels retained *Gonyaulax tamarensis* toxins for up to 60 days (depending on the initial level of contamination). Landsberg (1996) also suggested that there was a correlation between the incidence of neoplasia or tumours in bivalves and out-breaks of paralytic shellfish poisoning in which bivalves accumulate toxins from algal blooms, although a direct causal effect required further research. No information on the

	effects of nutrient enrichment on hydroids and bryozoans was found. An increase in abundance of red algae, including *Delesseria sanguinea*, was associated with eutrophication in the Skagerrak area, Sweden, especially in areas with the most wave exposure or water exchange (Johansson et al., 1998). However, where eutrophication resulted in high siltation rates, the delicate foliose red algae such as *Delesseria sanguinea* were replaced by tougher, erect red algae (Johansson et al., 1998). Therefore, given the potential sub-lethal effects of algal blooms and potential changes in the algal community an overall intolerance of low (at the benchmark level) has been recorded. A recoverability of very high has been recorded to represent the time required for algal toxins to be depurated from horse mussels.
Habitat structure changes - removal of substratum (extraction)	Removal of the substratum would result in the loss of the *Modiolus modiolus* bed and its associated community. Therefore, an intolerance of high has been recorded. The epifaunal organisms such as anthozoans, hydroids, barnacles, ascidians and brittlestars are likely to take some time to recolonize but could potentially recover within five years. However, *Modiolus modiolus* beds, are likely to take considerable time the recolonize and to develop into a bed similar in size and in the diversity and species richness they support (see additional information below). Therefore, a recoverability of very low has been recorded.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	*Modiolus modiolus* are large and relatively tough. Holt et al. (1998) suggested that horse mussel beds were not particularly fragile, even when epifaunal, with semi-infaunal and infaunal population being less vulnerable to physical disturbance. Clumps of horse mussels of muddy substrata may be more intolerant. However, impacts from towed fishing gear (e.g. scallop dredges) are known to flatten clumps and aggregations, may break off sections of raised reefs and probably damage individual mussels (Holt et al., 1998). The shells of older specimens can be very brittle due to infestations of the boring sponge *Cliona celata* (Comely, 1978; Holt et al., 1998). Holt et al., (1998) suggested that scallop dredging on areas adjacent to beds in the south east of the Isle of Man had 'nibbled away at the edges' of dense beds, which had become less dense and more scattered. Extensive beds were present to the north of the Isle of Man where scallop dredging had apparently not occurred (Holt et al., (1998). Magorrian & Service (1998) reported that queen scallop trawling resulted in flattening of the horse mussel bed and disruption of clumps of horse mussels and removal of emergent epifauna in Strangford Lough. They suggested that the emergent epifauna such as *Alcyonium digitatum* were more intolerant than the horse mussels themselves and reflected early signs of damage but were able to identify different levels of impact from impacted but largely intact to heavily trawled areas with few *Modiolus modiolus* intact, lots of shell debris and little epifauna (Service & Magorrian, 1997; Magorrian & Service, 1998; Service 1998). Veale et al., 2000 reported that the abundance, biomass and production of epifaunal assemblages, including *Modiolus modiolus* and *Alcyonium digitatum* decreased with increasing fishing effort. Species with fragile hard tests such as echinoids are known to be intolerant of scallop dredges (see Eleftheriou & Robertson, 1992; Veale et al., 2000). Scavengers such as *Asterias rubens* and *Buccinum undatum* were reported to be fairly robust to encounters with trawls (Kaiser & Spencer, 1995) may benefit in the short term, feeding on species damaged or killed by passing dredges. However, Veale et al. (2000) did not detect any net benefit at the population level. Scallop dredging was found to damage many of the epibenthic species found in association with Modiolus beds (Hill et al., 1997; Jones et al., 2000). Holt et al.

	(1998) suggested that damage by whelk potting was not likely to be severe but also noted that epifaunal populations may be more intolerant. Disruption of the clumps or beds may result in loss of some individual horse mussels suggesting an intolerance of intermediate, however, given the intolerance of epifauna suggested above an overall intolerance of high is recorded. Horse mussel recruitment is sporadic, varies with season, annually and with location and hydrographic regime and is generally low, therefore it may take many years for a population to recover from damage and a recoverability of low (10-25 years) has been recorded.
Siltation rate changes	Holt et al., (1998) point out that the deposit of spoil or solid wastes (e.g. from capital dredging) that settle as a mass will smother any habitat it lands on. MCR.ModT beds usually occur in areas of moderate to strong water flow (Holt et al., 1998) where accretion is probably reduced. Biogenic reef formation involves the build up of faecal mud, suggesting that adults can move up through the accreting mud to maintain their relative position within the growing mound. However, no information on natural accretion rates was found. Holt et al. (1998) note that there are no studies of the accretion rates that *Modiolus modiolus* beds can tolerate. Therefore, smothering by 5cm of sediment for a month (the benchmark level) is likely to remove a proportion of the horse mussel population. Red algae such as *Delesseria sanguinea* and *Phycodrys rubens* are probably large enough to tolerate smothering by 5cm of sediment, and encrusting coralline algae would probably survive under sediment for one month (see benchmark). *Ophiothrix fragilis* and *Balanus crenatus* are likely to be smothered by 5cm of sediment, and are not able to crawl up through the sediment. Hydroids are likely to be intolerant of smothering and siltation (see below), e.g. *Sertularia operculata* were reported to have died when covered by a fine layer of silt during periods of low water movement (Gili & Hughes, 1995). Therefore, a proportion of the horse mussel population and its associated community may be lost due to smothering and an intolerance of intermediate has been recorded. Hydroids and brittle stars may be more intolerant, therefore, species richness is likely to decline. Recruitment is sporadic, highly variable and some areas receive little or no recruitment for several years (see additional information below). Therefore, a recoverability of low has been recorded.
	Modiolus modiolus is found in a variety of turbid and clear water conditions (Holt et al., 1998). Muschenheim & Milligan (1998) noted that the height of the horse mussel beds in the Bay of Fundy positioned them within the region of high quality seston while avoiding high levels of re-suspended inorganic particulates (2.5-1500mg/l) at the benthic boundary layer. Comely (1978) noted that a population in a high turbidity area (up to 14mg/l in organic suspended particulates) showed excessive pearl formation and poor shell growth and condition, although the populations poor condition was probably partly due to old age and senility. Infaunal communities are probably exposed to high levels of suspended sediment at intervals (depending on variation in water flow and storms). Therefore, although high levels of suspended sediment may interrupt feeding, or result in the production of pseudofaeces at energetic cost, *Modiolus modiolus* is probably able to tolerate increases in suspended sediment for intervals equivalent to the benchmark and an intolerance of low has been recorded. Increases in organic suspended particulates may increase food availability and be beneficial. Horizontal surfaces in the subtidal tend to be algal dominated (where illumination permits) with animal dominated

	communities occurring on vertical or steep slopes (Hartnoll, 1983). However, the species identified as indicative of intolerance were assessed as 'low' intolerance to increase suspended sediment and siltation. Increased suspended sediment may clog or interfere with filter feeding or suspension feeding apparatus, which would require an energetic cost to clear. However, suspension feeders may benefit from an increase in organic particulates. Hydroids may be particularly intolerant e.g. *Sertularia operculata* were reported to have died when covered by a fine layer of silt during periods of low water movement (Gili & Hughes, 1995). In areas of strong tidal flow where the biotope MCR.ModT is found, an increase in suspended sediment may not result in a significant increase in siltation. Therefore, since the indicative species were of low intolerance to increases in suspended sediment an overall biotope intolerance of low has been recorded but a decline in species richness is likely due to loss of epifaunal hydroids. However, the biotopes SCR.ModCvar and SCR.ModHAs may be more intolerant of increased suspended sediment due to an increase in siltation in sheltered habitats. Most suspension feeders are likely to recover rapidly, however, a recoverability of very high has been recorded to represent the time required for hydroids to recover their original abundance or extent.
	A decrease in suspended sediment may decrease the food availability for *Modiolus modiolus* and other suspension feeding species. However, Navarro & Thompson (1996) demonstrated that *Modiolus modiolus* was adapted to seasonal fluctuations in food availability, reducing feeding activity in winter and increasing feeding activity during the summer phytoplankton bloom, for which it had a high absorption efficiency. Similarly, *Ophiothrix fragilis* has a low respiration rate and can tolerate considerable loss of body mass during reproductive periods (Davoult et al., 1990) so that restricted feeding may be tolerated. Therefore, *Modiolus modiolus* is unlikely to be adversely affected by a decrease in suspended sediment for a month (see benchmark). Overall, therefore, suspension feeders within the biotope may suffer reduced growth or condition due to reduced food availability and an intolerance of low has been recorded. Red algae may benefit from reduced suspended sediment due to reduced turbidity (see below).
Visual disturbance	Shading by passing boats may deter feeding by some fish species for short periods. However, it is unlikely to significantly affect predation pressure in the long term. Few other species have the visual acuity to be affected by the factor.
Introduction or spread of non-indigenous species.	Brown & Seed (1977) reported a low level of infestation (ca 2%) with pea crabs *Pinnotheres* sp. in Port Erin, Isle of Man and Strangford Lough. Comely (1978) reported that ca 20% of older specimens, in an ageing population, were damaged or shells malformed by the boring sponge *Cliona celata*. Infestation by the boring sponge reduces the strength of the shell and may render the population more intolerant of physical disturbance (see above). However, little other information concerning the effects of parasites or disease on the condition of horse mussels was found. *Echinus esculentus* is susceptible to 'Bald-sea-urchin disease', which causes lesions, loss of spines, tube feet, pedicellariae, destruction of the upper layer of skeletal tissue and death. Bald sea-urchin disease was recorded from *Echinus esculentus* on the Brittany coast. Although associated with mass mortalities of *Strongylocentrotus franciscanus* in California and *Paracentrotus lividus* in the French Mediterranean it is not known if the disease induces mass mortality (Bower,

	1996). However, no evidence of mass mortalities of *Echinus esculentus* associated with disease have been recorded in Britain and Ireland. Loss of sea-urchins may be detrimental to the horse mussel bed due to fouling (see ecological relationships). Evidence of sub-lethal effects alone was found in *Modiolus modiolus* and an intolerance of low has been recorded.
Introduction of microbial pathogens	Theede et al. (1969) examined the relative tolerance of gill tissue from several species of bivalve to exposure to 0.21mg/l O_2 with or without 6.67mg of sulphide (at 10°C and 30psu). *Modiolus modiolus* tissue was found to be the most resistant of the species studied, retaining some ciliary activity after 120hrs compared with 48hrs for *Mytlius edulis*. While it is difficult to extrapolate from tissue resistance to whole animal resistance (taking into account behavioural adaptations such as valve closure) this suggests that horse mussels are more, or at least similarly, tolerant of hypoxia and hydrogen sulphide to the common mussel. In addition, most bivalve molluscs exhibit anaerobic metabolism to some degree. Therefore, *Modiolus modiolus* was assessed as of low intolerance at the benchmark level. However, *Alcyonium digitatum*, *Ophiothrix fragilis* and *Delesseria sanguinea* were assessed as highly intolerant of deoxygenation, while *Echinus esculentus* was regarded as of intermediate intolerance. Hydroids mainly inhabit environments in which the oxygen concentration usually exceeds 5 ml/l and respiration is aerobic. Assimilation of oxygen occurs simply by diffusion through the epidermis of exposed tissues and transport to tissues is facilitated by hydroplasmic flow and ciliary activity (Hickson, 1901). *Ophiothrix fragilis* was known to have a low respiration rate (Migné & Davoult, 1997b), particularly during colder winter temperatures, however, extreme hypoxia was reported to cause mass mortality (Stachowitsch, 1984). The effects of deoxygenation in plants has been little studied and since plants produce oxygen they may be considered relatively insensitive. However, a study of the effects of anaerobiosis (no oxygen) on some marine algae concluded that *Delesseria sanguinea* was very intolerant of anaerobic conditions; at 15°C death occurred within 24hrs and no recovery took place although specimens survived at 5°C (Hammer 1972). Under hypoxic conditions echinoderms become less mobile and stop feeding . Death of a bloom of the phytoplankton *Gyrodinium aureolum* in Mounts Bay, Penzance in 1978 produced a layer of brown slime on the sea bottom. This resulted in the death of fish and invertebrates, including *Echinus esculentus*, presumably due to anoxia caused by the decay of the dead dinoflagellates (Griffiths et al., 1979). Although the horse mussels are probably tolerant of hypoxic condition, all the species indicative of intolerance were more intolerant, suggesting that the epifauna and epiflora would decrease in abundance or diversity under hypoxic conditions. Therefore, an overall intolerance of intermediate has been recorded. Recovery would depend on growth of surviving epifauna, or re-colonization and would probably require up to 5 years (see additional information below).
Removal of target habitat	No information concerning non-native species competitors was found.
Removal of non-target habitat	Holt et al. (1998) reported that, although there was no large scale horse mussel fishery in the United Kingdom, there have been small scale local fisheries in Scotland for food or bait and that horse mussels were occasionally seen on markets in Lancashire. Holt et al. (1998) suggested that any direct fishery would be very damaging. Horse mussels, *Modiolus modiolus*, are the

	key species within this biotope (MCR.ModT) and the biotopes it has been used to represent. Extraction of *Modiolus modiolus* would have severe consequences for the associated community. Scallop beds are known to be associated with or occur in the vicinity of *Modiolus modiolus* beds (Holt et al., 1998; Magorrian & Service, 1998). Holt et al. (1998) suggested that horse mussel beds were not particularly fragile, even when epifaunal, with semi-infaunal and infaunal population being less vulnerable to physical disturbance from fishing activity. Clumps of horse mussels of muddy substrata may be more intolerant. However, impacts from towed fishing gear (e.g. scallop dredges) are known to flatten clumps and aggregations, may break off sections of raised reefs and probably damage individual mussels (Holt et al., 1998). Holt et al. (1998) suggested that scallop dredging on areas adjacent to beds in the south east of the Isle of Man had 'nibbled away at the edges' of dense beds, which had become less dense and more scattered (Holt et al., 1998). Extensive beds were present in the north of the Isle of Man where scallop dredging has apparently not occurred (Holt et al., (1998). Magorrian & Service (1998) reported that queen scallop trawling resulted in flattening of horse mussel beds and disruption of clumps of horse mussels and removal of emergent epifauna in Strangford Lough. They suggested that the emergent epifauna such as *Alcyonium digitatum* were more intolerant than the horse mussels themselves and reflected early signs of damage. They were able to identify different levels of impact from impacted but largely intact beds to heavily trawled areas with few *Modiolus modiolus* intact, lots of shell debris and little epifauna (Service & Magorrian, 1997; Magorrian & Service, 1998; Service 1998). Veale et al. (2000) reported that the abundance, biomass and production of epifaunal assemblages, including *Modiolus modiolus* and *Alcyonium digitatum* decreased with increasing fishing effort. Scallop dredging was found to damage many of the epibenthic species found in association with Modiolus beds (Hill et al., 1997; Jones et al., 2000). Scavengers such as *Asterias rubens* and *Buccinum undatum* were reported to be fairly robust to encounters with trawls (Kaiser & Spencer, 1995) and may benefit in the short term, feeding on species damaged or killed by passing dredges. However, Veale et al. (2000) did not detect any net benefit at the population level. In addition, *Buccinum undatum* may itself be the subject of a fishery, although its removal may not adversely affect the biotope. Species with fragile hard tests such as echinoids are known to be intolerant of scallop dredges (see Eleftheriou & Robertson, 1992; Veale et al., 2000). Removal of sea urchins may have adverse effects of the horse mussel beds due to increased fouling and potential dislodgement or loss of clumps of mussels. Recovery will depend on recruitment of horse mussels and subsequent development of the beds, which may take many years (see additional information below). Brown (1989; cited in Ramsay et al., 2000) suggested that fishing activities may render the habitat unsuitable for recolonization by species such as *Modiolus modiolus*. The epifaunal organisms such as anthozoans, hydroids, barnacles, ascidians and brittlestars are likely to take some time to recolonize but could potentially recover within five years. However, *Modiolus modiolus* beds, are likely to take considerable time the recolonize and to develop into a bed similar in size and in the diversity and species richness they support (see additional information below). Therefore, a recoverability of very low has been recorded.

2.17	***Musculus discors* beds MCR.Mus**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	*Musculus discors* has a wide distribution extending from the Arctic Circle to the Mediterranean in western Europe. It is, therefore, unlikely to be affected by increases in temperature in British waters. Könnecker (1977) also suggested that *Musculus discors* associations were eurythermal. Similarly, many epifaunal species found in the biotope have a widespread distribution and are unlikely to be adversely affected by long term change within British waters. Short term acute change may have adverse effects, for example, reproduction in *Clavelina lepadiformis*, *Delesseria sanguinea* and hydroids is temperature dependant. However, loss of a few intolerant epifaunal or epifloral species will not significantly affect the biotope, and are likely to recover quickly. Therefore an intolerance of low has been recorded, with a recoverability of high (see additional information below).
Temperature changes - local decrease	*Musculus discors* has a wide distribution extending from the Arctic Circle to the Mediterranean in western Europe. It is, therefore, unlikely to be affected by decreases in temperatures or winter temperatures in British waters. Könnecker (1977) also suggested that *Musculus discors* associations were eurythermal. Many associated epifaunal species have a wide geographical distribution and are unlikely to be adversely affected by decrease in temperature within British waters. A few species may be more intolerant, e.g. *Clavelina lepadiformis*, *Delesseria sanguinea*, and *Pentapora fascialis* where they occur. However, loss or reduction of a few intolerant epifaunal species is unlikely to adversely affect the *Musculus discors* beds or the biotope as a whole. Therefore, an intolerance of low, with a high recoverability, has been recorded (see additional information below).
Salinity changes - local increase	This biotope occurs in full salinity and is unlikely to encounter increases in salinity.
Water flow (tidal current) changes - local increase	*Musculus discors* has been recorded from weak to strong tidal streams. It is, therefore, tolerant of water flow within this range. An increase to very strong tidal streams may result in loss of a proportion of the population physically removed by water flow, either due to removal of the animal itself or removal of the algae to which it was attached. Similarly, the associated epifaunal species will vary with water flow, resulting in an increase in species tolerant of increased water flow. Therefore, an intolerance of intermediate has been recorded. Recovery will probably take up to 5 years (see additional information below).
Water flow (tidal current) changes - local decrease	*Musculus discors* has been recorded from weak to strong tidal streams. It is, therefore, tolerant of water flow within this range. Decreases water flow will favour epifaunal species tolerant of reduced water flow over species that prefer high water flow rates, so that the composition of the epifaunal species will change. A decrease in water flow to negligible may result in a stagnant deoxygenated water (see deoxygenation) and increased siltation (see above). Overall, although species composition may change the biotope will not be adversely affected and an intolerance of low and a high recoverability has been recorded (see additional information below).

Emergence regime changes - local increase	An increase or decrease in tidal emergence is unlikely to affect circalittoral habitats, except that the influence of wave action and tidal streams may be increased (see water flow rate below).
Emergence regime changes - local decrease	An increase or decrease in tidal emergence is unlikely to affect circalittoral habitats, except that the influence of wave action and tidal streams may be increased (see water flow rate below).
Wave exposure changes - local increase	This biotope has been reported from areas of moderate wave exposure, whereas *Musculus discors* has been reported from wave exposed to extremely wave sheltered habitats and is therefore relatively insensitive to changes in wave exposure within this range. Should the wave exposure increase from exposed to extremely exposed, *Musculus discors* may be removed, even in the shallow subtidal, where the oscillatory water flow generated by wave action is likely to dislodge and remove at least a proportion of the population. Similarly, a proportion of the associated epifaunal species are also likely to be removed , being replaced by more wave tolerant species, e.g. *Tubularia indivisa*. Therefore, an intolerance of intermediate has been recorded. Recovery will probably take up to 5 years (see additional information below).
Wave exposure changes - local decrease	This biotope has been reported from areas of moderate wave exposure, whereas *Musculus discors* has been reported from wave exposed to extremely wave sheltered habitats and is therefore relatively insensitive to changes in wave exposure within this range. A decrease in wave exposure, e.g. from moderately exposed to very sheltered is likely to increase siltation and increase the risk of deoxygenated conditions (see below). The species composition of the epifauna is likely to change, favouring species tolerant of reduced wave action or water movement, e.g. the hydroid Nemertesia spp. Overall, however, the biotope is likely to be little affected and an intolerance of low has been recorded. Recoverability has been recorded as high, to represent the time taken for the epifauna to recover a similar species composition.
Water clarity increase	Decreased turbidity will result in increased light penetration, macroalgal growth and phytoplankton productivity, both of which may benefit *Musculus discors* by providing additional substratum for colonization and food respectively. Increased macroalgal growth, especially red algae, may compete for space with epifaunal hydroids and bryozoans, resulting in a change in epifaunal species composition and increased abundance of algae. However, overall, the biotope would be little affected and an intolerance of low has been recorded. Recoverability is likely to be very high.
Water clarity decrease	Increased turbidity will reduce phytoplankton productivity and may reduce food availability for *Musculus discors*, however, it is probably capable of utilizing other organic particulates so that the effects would probably be sub-lethal. Increased turbidity will also decrease the depth to which kelps and other macroalgae can grow, reducing their availability as substratum for *Musculus discors*. Brazier et al. (1999) reported that the waters around Holy Island where the *Musculus discors* beds were found, were highly turbid, and restricted kelps to the level of chart datum and red algae to depths of only 3- 4m. However, *Musculus discors* can utilize other substrata such as tunicates, animal turfs or hard substrata and is unlikely to be adversely affected. Increased turbidity is likely to decrease

	macroalgal cover, hence increasing potential space for *Musculus discors* and epifaunal species. Therefore, an intolerance of low has been recorded. Recovery will depend on recolonization of available space by macroalgae and may be rapid in the case of red algae or take many years in the case of kelps (see *Laminaria hyperborea* for example). Therefore a recoverability of high has been recorded.
Habitat structure changes - removal of substratum (extraction)	Removal of the substratum whether the macroalgae to which *Musculus discors* was attached, or the rocky substratum itself will result in loss of the community. Therefore, an intolerance of high has been recorded. Recoverability will depend on recruitment from adjacent or nearby populations and may take many years (see additional information below).
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	Physical disturbance at the benchmark level would probably physically remove some *Musculus discors* individuals from their substratum and break the shells of some individuals, depending on their size. Disturbance of the cohesive mat of individuals may strip away tracts of the biotope or create gaps or 'edges' that may allow peeling away of the *Musculus discors* mat by tidal streams or wave action. *Musculus discors* may be affected indirectly by physical disturbance that removes macroalgae to which they are attached. Erect epifaunal species are particularly vulnerable to physical disturbance. Hydroids and bryozoans are likely to be uprooted or damaged by bottom trawling or dredging and bryozoans repair damage slowly (Holt et al., 1995). Veale et al. (2000) reported that the abundance, biomass and production of epifaunal assemblages decreased with increasing fishing effort. Overall, physical disturbance at the benchmark level may remove or damage a proportion of the *Musculus discors* bed and its associated epifauna. Therefore, an intolerance of intermediate has been recorded. Recovery will probably take up to 5 years (see additional information below). However, large scale physical disturbance effects (e.g. from mobile fishing gear) may be more akin to substratum removal (see above).
Siltation rate changes	*Musculus discors* lives in fixed nests of byssus threads on the surface of the substratum. While the nest will protect the bivalve from the direct effects of smothering, they are unlikely to be able to burrow up through deposited spoil or other smothering agent. Smothered individuals will probably succumb to the effects of anoxia. Although, individuals on raised substrata such as the stipe of kelps may escape the effects of smothering, *Musculus discors* was considered to be highly intolerant. Large epifauna such as *Alcyonium digitatumrea*, *Nemertesia antennina*, large branching or globose sponges and anemones (e.g. *Urticina felina*) are unlikely to be adversely affected by smothering with 5cm of sediment. However, smaller or encrusting forms and some ascidians (e.g. *Clavelina lepadiformis*) may be adversely affected. Overall, however, loss of the *Musculus discors* population would result in loss of the biotope and a biotope intolerance of high has been recorded. Recoverability will depend on recruitment from adjacent or nearby population and may take many years (see additional information below).
	Dense beds of *Musculus discors* in the north of the Llyn Peninsula and Holy Island, Anglesey were reported to be covered by a thick layer of mucous congealed fine silt and their own pseudofaeces (Hiscock, 1984; Brazier et al., 1999). Brazier et al. (1999) reported that the waters around Holy Island where the *Musculus discors* beds were found, were highly turbid, and restricted kelps to the level of chart datum and red algae to depths of only 3-4m. Other dense aggregations of *Musculus discors* were reported from areas of strong tidal

	streams and presumably low levels of suspended sediment and siltation. Therefore, *Musculus discors* is probably tolerant of a wide range of suspended sediment levels. Increased suspended sediment concentrations may clog suspension feeding apparatus, lead to smothering of epifauna and cover the leaves of foliose algae, resulting in reduced photosynthesis. Therefore, the epifaunal community, especially of hydroids, bryozoans and ascidians is likely to change, with intolerant species replaced by sediment tolerant species. However, although the species richness will decline, the *Musculus discors* populations will probably be little affected and an overall biotope intolerance of low has been recorded. Recolonization and recovery of epifaunal species is likely to be rapid once the prior conditions return (see additional information below).
	Musculus discors is probably tolerant of a wide range of suspended sediment levels (see above). The species composition of associated epifaunal species is likely to vary with suspended sediment concentration, with sediment tolerant species being out-competed by fast growing, but less sediment tolerant species as the suspended sediment concentration decreases. Overall, although the associated epifaunal species may change and species richness decline temporarily, the *Musculus discors* carpet is unlikely to be adversely affected. Therefore, an intolerance of low has been recorded.
Visual disturbance	Few, if any, species within the biotope have a significant visual acuity, and are unlikely to respond to visual disturbance at the benchmark level.
Introduction or spread of non-indigenous species.	*Musculus discors* was reported to host the ciliate *Hypocomides musculus*, which was either parasitic or commensal. The metacercariae of the trematode *Gymnophallus* spp. were also reported to use *Musculus discors* as a secondary host (Lauckner, 1983). However, no effects were given. It is likely that any parasitic infestation will result in at least sub-lethal effects, therefore an intolerance of low has been recorded.
Introduction of microbial pathogens	De Zwaan & Mathieu (1992) suggested that members of the family Mytilidae were facultative anaerobes (capable of anaerobic respiration but preferring aerobic respiration) and were tolerant of a wide range of oxygen concentrations (euryoxic). The majority of evidence is derived from the study of Mytilus spp. and no information was found on Musculus spp. Hydroids inhabit mainly environments in which the oxygen concentration exceeds 5ml/l and respiration is aerobic (Gili & Hughes, 1995). *Delesseria sanguinea* was reported to be very intolerant of anaerobic conditions; at 15°C death occurs within 24hrs and no recovery takes place although specimens survived at 5°C. (Hammer 1972). Overall, *Musculus discors* probably exhibits facultative anaerobiosis and is probably tolerant of a degree of hypoxia, whereas some members of the associated epifauna are probably highly intolerant. Therefore, a proportion of the *Musculus discors* bed may be lost together with members of its epifauna, and an intolerance of intermediate has been recorded albeit at very low confidence. Recovery will probably take up to 5 years (see additional information below).
Removal of target habitat	No information found.

Removal of non-target habitat	*Musculus discors* is not known to be subject to extraction or harvesting. Laminarians are subject to harvesting and aquaculture (see *Laminaria hyperborea* for example). Therefore, removal of the macroalgae will result in removal of substratum and attached *Musculus discors* when they are abundant within the biotope (see Baldock et al., 1998 for example). However, members of the population on the surrounding rocky substratum may be unaffected, and removal of macroalgae may provide new substratum for colonization. Therefore, an intolerance of intermediate has been recorded at the benchmark level. Recovery will probably take up to 5 years (see additional information below).

2.18	Northern Sea fan communities MCR.ErSEun
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The biotope is found mainly in the south west of England and the west coast of Ireland. Long term increases in temperature may cause an increase in the abundance of the southern species that characterize it and more southern species may colonize the biotope. Expansion of the geographic range of the characterizing species may also expand the geographical range of the biotope northwards. In the case off an acute rise in temperature at the warmest time of year, it is not expected that temperature will be harmful as the characterizing species generally occur much further south than the British Isles. Overall, an increase in temperature is likely to be favourable to the presence of this biotope.
Temperature changes - local decrease	The distribution of the sponge *Axinella dissimilis* and the soft coral *Alcyonium digitatum* extend to Iceland so these species may be tolerant of long-term decreases in temperature. Long-term decrease in temperature is likely to lead to a poor year for recruitment of *Eunicella verrucosa* but is unlikely to lead to mortality. A live specimen collected from shallow depths off North Devon in 1973 exhibited growth rings that demonstrated that the colony had survived the 1962/63 cold winter. Also, large colonies were being collected from Lundy in the late 1960's suggesting no significant loss in 1962/63 (Keith Hiscock, own observations.). Assuming that temperature decrease reduces recruitment, the population size might decline for a year but recovery will occur following a successful recruitment. Therefore, it appears that the biotope may be able to tolerate a long term decrease in temperature. However, the response of these species to larger short term acute decrease are not known and may lead to a reduction in species diversity. Any losses are likely to be amongst species that recolonize rapidly. A rank of intermediate, but with very low confidence is reported.
Salinity changes - local increase	The biotope occurs only in fully saline waters (Connor et al., 1997a). The three selected key or important characterizing species are highly intolerant of decreases in salinity. Other characterizing species may also be highly intolerant of decreases in salinity. *Pentapora foliacea* has good reproductive and recolonizing abilities. It has been recorded as recovering in 3.5 years after almost total loss of a local population (Cocito et al., 1998(b)). *Eunicella verrucosa* is long lived, slow growing, and little is known of its reproduction. Sponges are often slow growing and long lived. Little is known of the reproduction and recruitment mechanisms in *Axinella dissimilis* or other sponges. Recovery of some parts of this community and biotope may take a long time. Other species are annuals and may have long-lived widely dispersing larvae. Many of the species in the biotope (including the 3 selected characterizing species) have permanent attachments to the substratum so immigration of adults into the biotope is not possible. Mobile species such as the echinoderms and fish may be able to return more rapidly.

Water flow (tidal current) changes - local increase	The biotope consists mainly of species firmly attached to the substratum and which would be unlikely to be displaced by an increase in the strength of tidal streams. Many of the species in this biotope are suspension feeders and rely to some extent on water flow to ensure their food supply. However, an increase in tidal flow rate to strong or greater (i.e. above 3 knots) may cause loss of posture and interfere with feeding mechanisms, particularly in the more delicate species like hydroids. Mobile species may be displaced or washed away but species such as the echinoderms and fish may be able to return rapidly after flow rates return to normal. There would be loss of feeding and a decline in species richness as mobile species might be swept away.
Water flow (tidal current) changes - local decrease	Many of the species in this biotope are suspension feeders and rely to some extent on water flow to ensure their food supply. Also, reduced water flow is likely to lead to siltation and therefore effects similar to those described in 'smothering'. Overall, the long-lived, slow growing and poor recruitment species are likely to survive albeit with reduced food supply and a small number of other species may succumb to smothering.
Emergence regime changes - local increase	The biotope is entirely subtidal and will not be subject to emergence.
Emergence regime changes - local decrease	The biotope is entirely subtidal and is not subject to emergence.
Wave exposure changes - local increase	The biotope exists in moderately exposed areas (Connor et al., 1997(a)). Increases in wave exposure may interfere with the posture of upright species in the biotope. Sea fans will be detached from the substratum by storms. For example, detached colonies are frequently seen on the seabed and after severe storms may be washed-up on the strandline. The surface of *Axinella dissimilis* cracks if bent more than 90°; (Moss & Ackers, 1982). After prolonged easterly gales in the winter of 1987 at Lundy, branching sponges were damaged and some lost from monitoring sites (K. Hiscock pers. comm.). The erect bryozoan *Pentapora foliacea* has brittle lamellae and is known to be severely damaged by extreme wave action (Cocito et al., 1998(a)). The biotope MCR.PhaAxi occurs in more wave exposed areas although the effects of wave action would be reduced in the deeper waters in which the biotope occurs. Many of the species are sessile and attached to the substratum so supplementation of the population through immigration of adults is not possible. Mobile species such as the echinoderms and fish may be able to return more rapidly. *Pentapora foliacea* has some regenerative ability as well as good reproductive and recolonizing abilities. It has been recorded as recovering in 3.5 years after almost total loss of a local population (Cocito et al., 1998(b)). *Eunicella verrucosa* is long lived, slow growing, and little is known of its dispersal and reproduction. Little is known of the reproduction and recruitment mechanisms in *Axinella dissimilis* or other sponges. Some annual species such as *Nemertesia ramosa* are annuals and recruit readily over short distances. Providing that not all individuals of the characterizing species are lost during a storm, the biotope will remain but recovery to previous abundances in likely to take a long time so recovery is rated low.

Wave exposure changes - local decrease	Whilst water movement is required to bring food to suspension feeding species in the biotope, tidal streams are generally more important than wave oscillation in doing so. However, decreased wave exposure may lead to increased siltation and smothering effects. Therefore, some loss of species living close to the substratum might occur. Those species are generally fast to settle and grow.
Water clarity increase	Decreased turbidity is likely to lead to increased algal growth with the potential to smother some of the species especially where they live close to the seabed. Also, drift from ephemeral algae growing as a result of increased water clarity may clog branches of sea fans and branching sponges reducing feeding ability. Effects of increased algal growth on this biotope have been observed at Lundy (Keith Hiscock, own observations) where the biotope and its component long lived, slow-growing and poorly recruiting components persisted. There effects are likely to be short-term and result in reduced feeding ability.
Water clarity decrease	The biotope occurs in the circalittoral and none of the characterizing species are algae likely to be adversely affected by decreased light levels. However, increased turbidity is usually caused by increased silt levels in the water so that the intolerance and recoverability characteristics are likely to be similar.
Habitat structure changes - removal of substratum (extraction)	Most of the characteristic species in the biotope are permanently attached to the substratum (e.g. the sponges, sea fans and bryozoans) and will not re-attach once displaced. Substratum loss will result in loss of these species and so intolerance of the biotope is high. *Pentapora foliacea* has good reproductive and recolonizing abilities. It has been recorded as recovering in 3.5 years after almost total loss of a local population (Cocito et al., 1998b). *Eunicella verrucosa* is long lived, slow growing, and little is known of its reproduction. It is known to colonize wrecks at least several hundred metres from other hard substrata with sea fans, but is thought to have larvae which generally settle near the parent. Little is known of the reproduction and recruitment mechanisms in *Axinella dissimilis* or other sponges but branching sponges have not been observed to colonize wrecks and growth rate of *Axinella dissimilis* at Lundy is extremely slow (less than 1mm a year) (K. Hiscock, pers. comm.). In monitoring studies at Lundy, branching sponges showed no recruitment, only losses over a 13 year period (K. Hiscock pers. comm.). Recovery of some parts of this community may therefore take a long time or not occur. Other species in the biotope may have long-lived widely dispersing larvae. Mobile species such as the echinoderms and fish should be able to return rapidly.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	The three selected key or important characterizing species in this biotope are highly or intermediately intolerant of abrasion. Other species in the biotope that are upright and protrude above the substratum will also be damaged or killed by abrasion (e.g. hydroids, branching and cup sponges etc). Also, mobile surface species that are not fast movers, for example *Echinus esculentus*. *Pentapora fascialis* has good reproductive and recolonizing abilities. It has been recorded as recovering in 3.5 years after almost total loss of a local population (Cocito et al., 1998b). *Eunicella verrucosa* is long lived, slow growing, and little is known of its reproduction. Nevertheless, *Eunicella verrucosa* does appear to recruit well providing there are extant populations nearby. On the other hand, *Axinella polypoides* (one of the species often present in the biotope) is unlikely to recover if lost (Keith Hiscock, pers comm.). Sponges are often slow growing and long lived. Little is known of the reproduction and recruitment mechanisms in *Axinella dissimilis* or other

	sponges. Recovery of some parts of this community and biotope may take a long time. Other species are annuals and may have long-lived widely dispersing larvae. Many of the species in the biotope (including the 3 selected characterizing species) have permanent attachments to the substratum so immigration of adults into the biotope is not possible. Mobile species such as the echinoderms and fish will be able to return more rapidly.
Siltation rate changes	Some of the species in the biotope are upright and branching (e.g. *Axinella dissimilis* and *Eunicella verrucosa*). These species project above the substratum to sufficient height not to be covered completely by 5 cm of sediment and consequently may not be killed by smothering. Other more low lying or encrusting species (encrusting sponges, hydroids, bryozoans etc.) are more likely to be completely covered and will probably die. Many of the species are sessile and attached to the substratum so recovery of the population through immigration of adults is not possible. Mobile species such as the echinoderms and fish may be able to return more rapidly. *Pentapora fascialis* has some regenerative ability as well as good reproductive and recolonizing abilities. It has been recorded as recovering in 3.5 years after almost total loss of a local population (Cocito et al., 1998b). Some species such as *Nemertesia ramosa* are annuals and recruit readily over short distances. The long-lived slow growing and infrequently recruiting species are likely to survive smothering and the ones that are likely to be lost are also likely to recolonize within a few years. Recovery of the biotope as a whole is, however, likely to take more than five years. Therefore, a recovery rank of moderate is suggested.
	Many of the species are suspension feeders and increase in suspended sediment may cause interference and blockages, for example in sponge canals and pores. However, the anthozoans and sponges produce mucus which is shed with attached silt to clean the external surface. Mortality is not therefore expected with increased suspended sediment levels but some reduction in fitness may occur as a result of energy being expended in cleaning.
	Many of the species are suspension feeders and decrease in suspended sediment may reduce interference and blockages, for example of sponge canals and pores. However, the species in the biotope may rely of suspended organic material that is a part of the suspended material for feeding. Overall, there are both likely favourable and unfavourable effects of decrease in suspended sediment so that not sensitive is indicated.
Underwater noise changes	It is unlikely that any of the benthic key or important characterizing species are sensitive to noise disturbance. Some of the biotopes characterizing species, namely the wrasse (*Labrus bergylta*, *Labrus mixtus*), may have low intolerance to noise but this will not have a major impact on the biotope as a whole.
Visual disturbance	It is unlikely that any of the benthic key or important characterizing species are sensitive to visual presence. Some of the characterizing species in the biotope, namely the wrasse (*Labrus bergylta*, *Labrus mixtus*), may have low intolerance to visual disturbance but this will not have a major impact on the biotope as a whole.
Introduction or spread of non-indigenous species.	Insufficient information

Introduction of microbial pathogens	No information is directly available regarding the biotopes or the selected characterizing species tolerance to decreases in oxygenation. *Pentapora fascialis* and *Axinella dissimilis* have been assessed as of intermediate intolerance. Many of the species are sessile and attached to the substratum so supplementation of the population through immigration of adults is not possible. Mobile species such as the echinoderms and fish may be able to return more rapidly. *Pentapora foliacea* has some regenerative ability as well as good reproductive and recolonizing abilities. It has been recorded as recovering in 3.5 years after almost total loss of a local population (Cocito et al., 1998b). *Eunicella verrucosa* is long lived, slow growing, and little is known of its dispersal and reproduction. Little is known of the reproduction and recruitment mechanisms in *Axinella dissimilis* or other sponges. Some annual species such as *Nemertesia ramosa* are annuals and recruit readily over short distances. Recovery of the biotope as a whole is likely to take a long time.
Removal of target habitat	Insufficient information
Removal of non-target habitat	It is extremely unlikely that *Pentapora fascialis* would be targeted for extraction. However, *Eunicella verrucosa* is sometimes taken illegally (it is protected under schedule 5 of the Wildlife and Countryside Act 1981 against killing, injuring, taking possession and sale and is the subject of a UK Biodiversity Action Plan). *Echinus esculentus*, a characterizing species in the biotope, is also collected and an intolerance of intermediate has been suggested with a low recovery. If, however, the biotope was targeted indirectly for other species, the damage resulting from bottom fishing would be considerably more severe and this has been addressed under Physical Disturbance.

2.19	***Ostrea edulis* IMX.Ost**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Filtration rate, metabolic rate, assimilation efficiency and growth rates of adult *Ostrea edulis* increase with temperature. Growth was predicted to be optimal at 17°C or, for short periods, at 25°C (Korringa, 1952; Yonge, 1960; Buxton et al., 1981; Hutchinson & Hawkins, 1992). Huchinson & Hawkins (1992) noted that temperature and salinity were co-dependant, so that high temperatures and low salinity resulted in marked mortality, no individuals surviving more than 7 days at 16psu and 25°C, although these conditions rarely occurred in nature. No upper lethal temperature was found, although Kinne (1970) reported that gill tissue activity fell to zero between 40-42°C, although values derived from single tissue studies should be viewed with caution. Buxton et al. 1981 reported that specimens survived short term exposure to 30°C. *Ostrea edulis* and many of the other species in the biotope occur from the Mediterranean to the Norwegian coast and are unlikely to be adversely affected by long term changes in temperatures in Britain and Ireland. Spärck's data (1951) suggest that temperature is an important factor in recruitment of *Ostrea edulis*, especially at the northern extremes of its range and Korringa (1952) reported that warm summers resulted in good recruitment. Spawning is initiated once the temperature has risen to 15-16°C, although local adaptation is likely (Korringa, 1952; Yonge, 1960). Davis & Calabrese (1969) reported that larvae grew faster with increasing temperature and that survival was optimal between from 12.5 - 27.5°C but that survival was poor at 30°C. Therefore, recruitment and the long term survival of an oyster bed is probably affected by temperature and may benefit from both short and long term increases. Most of the other characterizing species within the biotope have a wide distribution in Europe suggesting that they are able tolerate a wider range of temperatures than found in British waters. Delicate species may not be so tolerant and mobile species may leave the biotope temporarily resulting in a decline in species richness. However, an overall biotope intolerance of low has been recorded to represent the effects of temperature on feeding and growth. Once the temperature returns to normal limits the characterizing species will probably regain their condition rapidly.
Temperature changes - local decrease	Hutchinson & Hawkins (1992) suggested that *Ostrea edulis*, the dominant species in this biotope, switched to a reduced, winter metabolic state below 10°C that enabled it to survive low temperatures and low salinities encountered in shallow coastal waters around Britain. Davis & Calabrese (1969) also noted that larval survival was poor at 10°C. Korringa (1952) reported that British, Dutch and Danish oysters can withstand 1.5°C for several weeks. However, heavy mortalities of native oyster were reported after the severe winters of 1939/40 (Orton, 1940) and 1962/63 (Waugh, 1964). Mortality was attributed to relaxation of the adductor muscle so that the shell gaped, resulting in increased susceptibility to low salinities or to clogging with silt. Low temperatures and cold summers are correlated with poor recruitment in *Ostrea edulis*, presumably due to reduced food availability and longer larval developmental time, especially at the northern limits of its range. Therefore, a reduction in temperature may result in reduced recruitment and a greater variation in the populations of *Ostrea edulis*. The severe winters of 1939/40 and 1962/63 (Orton, 1940; Waugh, 1964)

	also resulted in the death of associated fauna, e.g. *Sabella pavonina* and other polychaetes died in great numbers, *Crepidula fornicata* incurred about 25% mortality and *Ocenebra erinacea* died in large numbers, while only small *Carcinus maenas* remained on the beds (Orton, 1940; Waugh, 1964). However, starfish, crabs such as *Hyas araneus* and *Urosalpinx cinerea* and *Ascidiella aspersa* were little affected (Orton, 1940; Waugh, 1964). Decreases in temperature experienced in a severe winter are more extreme than our benchmark. However, long term decreases in temperature could potentially effects overall recruitment and other members of the community are intolerant of short term acute decreases in temperature. Therefore, an overall biotope intolerance of intermediate intolerance has been suggested at the benchmark level. Recruitment in *Ostrea edulis* is sporadic and dependant of the hydrographic regime and local environmental conditions but will be enhanced by the presence of adults and shell material. Therefore a recoverability of low has been recorded (see additional information below).
Salinity changes - local increase	This biotope is found subtidally in full to variable salinity waters and is unlikely to experience increased salinity waters. Hyper-saline effluent may be damaging but no information concerning the effects of increased salinity on oyster beds was found.
Water flow (tidal current) changes - local increase	This biotope occurs in weak to very weak tidal streams. An increase in water flow from, for example weak to strong is likely to remove (erode) fine particulates, leaving coarser substrata and making more hard substratum available for settlement by oysters and other members of the community, e.g. *Ascidiella* spp. and epifauna. The effects of increased water flow are most likely to be in reducing the time oysters are able to feed. Oysters may be swept away by strong tidal flow if the substratum to which they are attached is removed. Therefore, a proportion of the oyster bed may be lost, depending on the nature of the substratum, and an intolerance of intermediate has been recorded. Overall, the nature of the biotope is likely to change significantly. Recruitment in *Ostrea edulis* is sporadic and dependant of the hydrographic regime and local environmental conditions but will be enhanced by the presence of adults and shell material. Therefore, a recoverability of low has been recorded (see additional information below).
Water flow (tidal current) changes - local decrease	The biotope is found in weak to very weak tidal streams, so that any further decrease is unlikely.
Emergence regime changes - local increase	The adult oyster can close the valves of its shell tightly when exposed. Some populations are found in the lower intertidal. A change of one hour in emergence would mean that the valves are kept shut for a greater time, resulting in less time available for feeding, and hence reduced growth and reproductive capacity, and an increased risk of desiccation. However, the epifauna are likely to be more intolerant of increases in emergence, resulting in loss of some species and a reduction in species richness. The infauna species are likely to be protected by their burrowing habit. Overall, therefore, the biotope may suffer a decrease in the diversity of epifauna but the oyster bed would not be markedly affected at the level of the benchmark. Therefore an intolerance of low has been recorded. The oysters would probably recover condition rapidly, and the epifauna will probably also recolonize available habitat quickly.

Emergence regime changes - local decrease	This biotope is subtidal so that an increase in emergence is unlikely to have an adverse effect on the community. However, increased emergence may allow the oyster bed to spread further up the shore, although at a slow rate. Therefore, the biotope may benefit from the factor.
Wave exposure changes - local increase	This biotope is found in sheltered to extremely sheltered conditions. Although subtidal, wave action in shallow water results in oscillatory water flow, the magnitude of which is greatest in shallow water and attenuated with depth. While the oysters' attachment is permanent, increased wave action may result in erosion of its substratum and the oysters with it. Areas where sufficient shell debris has accumulated may be less vulnerable to this disturbance. However, a proportion of the bed is likely to be displaced by an increase in wave action. Similarly, infaunal species, burrowing polychaetes and epifauna are characteristic of wave sheltered conditions and may be lost, e.g. *Ascidiella* sp. The biotope may be replaced by communities characteristic of stronger wave action and coarser sediments. Therefore, an intolerance of high has been recorded. Recruitment in *Ostrea edulis* is sporadic and dependant of the hydrographic regime and local environmental conditions but will be enhanced by the presence of adults and shell material. Therefore a recoverability of very low has been recorded (see additional information below).
Wave exposure changes - local decrease	This biotope is found in sheltered to extremely sheltered conditions. Therefore, a further reduction in wave exposure is unlikely to have any adverse effects.
Water clarity increase	A decrease in turbidity and hence increased light penetration may result in increased phytoplankton production and hence increased food availability for suspension feeders, including *Ostrea edulis*. Therefore, reduced turbidity may be beneficial. However, increased fouling by red algae may result and compete with juveniles and settling spat for space.
Water clarity decrease	The native oyster has no dependence on light availability so changes in turbidity would have no effect. However, increased turbidity may decrease primary production by phytoplankton and hence food availability. The characteristic red algae found in this biotope will suffer reduced primary production and growth but are probably shade tolerant but may be lost from deeper examples of this biotope. Therefore, an intolerance of low has been recorded. Once conditions returned to prior levels condition would probably be recovered rapidly.
Habitat structure changes - removal of substratum (extraction)	*Ostrea edulis* cements its lower valve to the substratum permanently. Loss of the substratum would result in loss of the oyster bed and its associated community and hence the biotope. Therefore an intolerance of high has been recorded. Loss of the substratum would also result in loss of the epifauna and infauna and, hence a major decline in species richness. Recovery is dependant on larval recruitment since adult *Ostrea edulis* are permanently attached and incapable of migration. Recruitment of *Ostrea edulis* is sporadic and dependant on the local environmental conditions, hydrographic regime and the presence of suitable substratum, especially adult shells or shell debris, and has probably been inhibited by the presence of competition from non native species (see additional information below). Since the biotope is dependant on the presence of *Ostrea edulis* a recoverability of very low has been suggested.

Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	Abrasion may cause damage to the shell of *Ostrea edulis*, particularly to the growing edge. Regeneration and repair abilities of the oyster are quite good. Power washing of cultivated oysters routinely causes chips to the edge of the shell increasing the risk of desiccation. This damage is soon repaired by the mantle. Oysters were often harvested by dredging in the past, which their shells survived relatively intact. However, a passing scallop dredge is likely to remove a proportion of the population. On mixed sediments, the dredge may remove the underlying sediment and cobbles and shell material with effects similar to substratum loss above. Polychaetes and other segmented worms were reported to be badly affected by oyster dredging while any bivalves were displaced (Gubbay & Knapman, 1999). In addition, the epifauna associated with horse mussel beds (*Modiolus modiolus*) was found to be particularly sensitive to abrasion due to scallop dredging (see MCR.ModT; Service & Magorrian, 1997). Therefore *Ostrea edulis* and the other characterizing species are probably sensitive to physical disturbance at the benchmark level and a biotope intolerance of intermediate has been recorded. See 'extraction' below for the effects of fishing on native oyster populations. Recovery will depend on recolonization by the epifaunal and infaunal species, most of which are widespread with dispersive pelagic larvae. However, recruitment in *Ostrea edulis* is sporadic and dependant of the hydrographic regime and local environmental conditions but will be enhanced by the presence of adults and shell material. Therefore a recoverability of moderate has been recorded (see additional information below).
Siltation rate changes	Smothering by 5 cm of sediment would prevent the flow of water through the oyster that permits respiration, feeding and removal of waste. *Ostrea edulis* is permanently fixed to the substratum and would not be able to burrow up through the deposited material. *Ostrea edulis* can respire anaerobically, and is known to be able to survive for many weeks (Yonge, 1960) or 24 days (Korringa, 1952) out of water at low temperatures used for storage after collection. However, it is likely that at normal environmental temperatures, the population would be killed by smothering. Yonge (1960) reported death of populations of *Ostrea edulis* due to smothering of oyster beds by sediment and debris from the land as a result of flooding. Therefore, an intolerance of high has been recorded. Smothering will probably also kill the sessile, fixed members of the epifauna, unless large enough to protrude above the deposited layer, e.g. *Ascidiella* sp. However, burrowing infauna will probably burrow to the surface. Death of the oyster bed will exacerbate changes in the sediment surface and nutrient levels in the long term, so that the characterizing species may be replaced by others. Therefore, species richness is likely to decline markedly. Recruitment in *Ostrea edulis* is potentially good due to its high fecundity and high dispersal potential, however, dependency of the hydrographic regime, and environmental conditions of (e.g. temperature, food availability), high larval and juvenile mortality, competition for settlement space with native species results in sporadic recruitment, which together with competition for suitable substratum with non native species such as *Crepidula fornicata* results in a potentially long recovery time (see additional information below). In addition, a layer of settled material of 1-2 mm in depth was reported to prevent satisfactory oyster sets, i.e. settlement, reducing effective recruitment (Galtsoff, 1964, cited in Wilbur, 1971). Therefore, a recoverability of very low has been recorded.

	Oysters respond to an increase in suspended sediment by increasing pseudofaeces production with occasional rapid closure of their valves to expel accumulated silt (Yonge, 1960) both of which exert an energetic cost. Korringa (1952) reported that an increase in suspended sediment decreased the filtration rate in oysters. Suspended sediment was also shown to reduce the growth rate of adult *Ostrea edulis* and to result in shell thickening (Moore, 1977). Reduced growth probably results from increased shell deposition and an inability to feed efficiently. Hutchinson & Hawkins (1992) reported that filtration was completely inhibited by 10mg/l of particulate organic matter and significantly reduced by 5mg/l. *Ostrea edulis* larvae survived 7 days exposure to up to 4 g/l silt with little mortality. However, their growth was impaired at 0.75 g/l or above (Moore, 1977). Yonge (1960) and Korringa (1952) considered *Ostrea edulis* to be intolerant of turbid (silt laden) environments. However, oyster beds are found in the relatively turbid estuarine environments and the values of suspended sediment quoted above are high in comparison to the benchmark value. Therefore, a change in suspended sediment at the bench mark level may only result in sub-lethal effects. However, Moore (1977) reported that variation in suspended sediment and silted substratum and resultant scour was an important factor restricting oyster spat fall, i.e. recruitment. Therefore, an increase in suspended sediment may have longer term effects of the population by inhibiting recruitment, especially if the increase coincided with the peak settlement period in summer. The other suspension feeders characteristic of this biotope are probably tolerant of a degree of suspended sediment but an increase, especially of fine silt, would probably interfere with feeding mechanisms, resulting in reduced feeding and a loss of energy through mechanisms to shed or remove silt. Overall, an increase in suspended sediment at the level of the benchmark for a period of a month, may not adversely affect the biotope. Therefore, an intolerance of low has been recorded. However, high levels of suspended sediment or a protracted increase may be detrimental. Recovery will depend on clearance of filtration apparatus and return to condition, which will probably be relatively rapid.
	In areas of high suspended sediment, a decrease may result in improved condition and recruitment due to a reduction in the clogging of filtration apparatus of suspension feeders and an increase in the relative proportion of organic particulates. However, a decrease in suspended sediments in some areas may reduce food availability resulting in lower growth or reduced energy for reproduction. Therefore, an intolerance of low has been recorded at the level of the benchmark.
Introduction or spread of non-indigenous species.	Numerous diseases and parasites have been identified in oysters, partly due to their commercial importance and partly because of incidences of disease related mass mortalities in oyster beds. Diseases in oysters and other commercial bivalve species may be caused by bacteria (especially in larvae), protists, fungi, coccidians, gregarines, trematodes, while annelids and copepods may be parasite. The reader should refer to reviews by Lauckner (1983) and Bower & McGladdery (1996) for further detail. For example, the following species have caused mortalities in *Ostrea edulis* populations in the UK: *Polydora ciliata* burrows into the shell, weakening the shell and increasing the oysters vulnerability to predation and physical damage, whereas *Polydora hoplura* causes shell blisters; boring sponges of the genus Cliona may bore the shell of oysters caused shell weakening, especially in older specimens; the flagellate protozoan Heximata sp. resulted in mass mortalities on natural and cultivated

	beds of oysters in Europe in the 1920-21, from which many population did not recover (Yonge, 1960); The parasitic protozoan *Bonamia ostreae* caused mass mortalities in France, the Netherlands, Spain, Iceland and England after its accidental introduction in 1980's resulting a further reduction in oyster production (Edwards, 1997); another protozoan parasite *Marteilia refingens*, present in France has not yet affected stocks in the British Isles, and the copepod parasite, *Mytilicola intestinalis*, of mussels, has also been found to infect *Ostrea edulis* potentially causing considerable loss of condition, although in most infections there is no evidence of pathology. No information on the effects of diseases and parasites on the associated species was found. However, various diseases are associated with mass mortality in oyster beds and an overall intolerance of high has been recorded. Recovery is dependant on larval recruitment since the adults are permanently attached and incapable of migration. Recruitment is sporadic and dependant on the local environmental conditions, hydrographic regime and the presence of suitable substratum, especially adult shells or shell debris, and has probably been inhibited by the presence of competition from non native species (see additional information below). Therefore, a recoverability of very low has been suggested.
Introduction of microbial pathogens	Oysters were considered to be tolerant of long periods of anaerobiosis due to their ability to survive out of water during transportation for long periods of time, and many weeks at low temperatures (Korringa, 1952; Yonge, 1960). For example, Lenihan (1999) reported that *Crassostrea virginica* could withstand hypoxic conditions (<2mg O_2 /l) for 7-10 days at 18°C but last for several weeks at <5°C. However, Lenihan (1999) also suggested that many days (26) of hypoxia, contributed to the high rate of mortality observed at the base reefs at 6m depth together with poor condition, parasitism and reduced food availability. In addition, a prolonged period of hypoxia in the River Neuse (North Carolina) resulted in mass mortality of oysters (Lenihan, 1999). Members of the characterizing species that occur in estuaries e.g. *Ascidiella aspersa* are probably tolerant of a degree of hypoxia and occasional anoxia. Similarly, most polychaetes are capable of a degree of anaerobic respiration (Diaz & Rosenberg, 1995). However, periods of hypoxia and anoxia are likely to result in loss of some members of the infauna and epifauna within this biotope. Overall, oysters are probably tolerant of hypoxia at the level of the benchmark and an intolerance of low has been recorded, although the biotope is likely to experience a decrease in species richness. Recovery will depend on recolonization by the associated fauna and flora and is likely to be rapid.
Removal of target habitat	The slipper limpet *Crepidula fornicata* was introduced with American oyster between 1887-1890 and has became a serious pest on oyster beds. *Crepidula fornicata* competes for space with oyster, and the build up of its faeces and pseudofaeces smothers oysters and renders the substratum unsuitable for settlement (Blanchard, 1997; Eno et al., 1997, 2000). Where abundant, *Crepidula fornicata* may prevent recolonization by *Ostrea edulis*. The American oyster drill *Urosalpinx cinerea* was first recorded in 1927 and occurs in south east and south west of the UK. *Urosalpinx cinerea* is a major predator of oyster spat and was considered to be a major pest on native and cultured oyster beds (Korringa, 1952; Yonge, 1960) and contributed to the decline in oyster populations in the first half of the 20th century. The above species may cause marked effects on UK oyster beds, especially *Crepidula fornicata* that may change the entire biotope, to produce a *Crepidula fornicata* dominated biotope (see IMX.CreAph). Therefore, an intolerance of high has been recorded. The

	loss of the oyster population will result in loss of the biotope and many of its associated species. Recovery is dependant on larval recruitment since the adults are permanently attached and incapable of migration. Recruitment is sporadic and dependant on the local environmental conditions, hydrographic regime and the presence of suitable substratum, especially adult shells or shell debris, and has probably been inhibited by the presence of competition from non native species (see additional information below). Therefore, a recoverability of very low has been suggested.
Removal of non-target habitat	The introduction of oyster dredging in the mid 19th century developed the oyster beds into a major fishery. However, by the late 19th century stocks were beginning to be depleted so that by the 1950s the native oyster beds were regarded as scarce (Korringa, 1952; Yonge, 1960; Edwards, 1997). This biotope is still regarded as scarce today. Over-fishing, combined with reductions in water quality, cold winters (hence poor spat fall), flooding, the introduction of non-native competitors and pests (see above), outbreaks of disease and severe winters were blamed for the decline (Korringa, 1952; Yonge, 1960; Edwards, 1997). As a result, although 700 million oysters were consumed in London alone in 1864, the catch fell from 40 million in 1920 to 3 million in the 1960s, from which the catch has not recovered (Edwards, 1997). Loss of the *Ostrea edulis* population would result in loss of the associated biotope. Therefore, while over-fishing was not the sole cause of the overall decline of UK *Ostrea edulis* population it was nevertheless a major contributing factor. Hence, while the benchmark would otherwise result in an intolerance of intermediate, due to the demonstrable potential effects of fishing on this biotope, an intolerance of high has been recorded. Recovery is dependant on larval recruitment since the adults are permanently attached and incapable of migration. Recruitment is sporadic and dependant on the local environmental conditions, hydrographic regime and the presence of suitable substratum, especially adult shells or shell debris, and has probably been inhibited by the presence of competition from non native species (see additional information below). Therefore, a recoverability of very low has been suggested.

2.20	**Peat and Clay exposures IR.ALcByH**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Species that dominate this biotope are mainly widespread in the north-east Atlantic and, although there may be some change in dominant species (for instance, the southern species *Distomus variolosus* replacing the very similar *Dendrodoa grossularia*) the biotope is not expected to change greatly. Short term acute changes are not thought likely to have an adverse effect. Increase in temperature may encourage colonization by southern species that are currently rare or scarce, especially the cluster coral *Hoplangia durotrix* and the soft coral *Alcyonium hibernicum*.
Temperature changes - local decrease	Species that dominate this biotope are mainly widespread in the north-east Atlantic and, although there may be some change in dominant species (for instance, the northern species *Dendrodoa grossularia* replacing the very similar southern species *Distomus variolosus*, the biotope is not expected to change greatly. For recoverability, see Additional information below.
Salinity changes - local increase	The biotope and similar biotopes is found in full salinity, therefore a further increase in salinity is unlikely.
Water flow (tidal current) changes - local increase	The community in this biotope is predominantly of suspension feeding species. The passive suspension feeders at least are likely to especially benefit from increased flow of water and therefore increased supply of food. Increased flow of water will also remove silt. Overall, the effect is expected to be favourable to species richness and productivity. However, the species richness may decline if one or a small number of species become dominant as a result of the increased food supply.
Water flow (tidal current) changes - local decrease	The community in this biotope is predominantly of suspension feeding species. The passive suspension feeders at least are likely to be adversely affected by decreased flow of water and therefore decreased supply of food. Decreased flow of water may also allow silt to settle with the possibility of clogging feeding organs. Overall, the effect is expected to be unfavourable to species richness and productivity. For recoverability, see Additional information below.
Emergence regime changes - local increase	Although this biotope may be exposed to air during low water of spring tides, it is composed of species that are normally fully immersed. If emergence increased by the equivalent of a change in one zone in already lower shore examples of the biotope, several species would be likely to be killed. For recoverability, see Additional information below.
Emergence regime changes - local decrease	This biotope is normally fully submerged and would most likely benefit if occasional exposures to air ceased.

Wave exposure changes - local increase	The biotope occurs in wave exposed situations. In a location where increase in wave exposure was from moderately exposed to very exposed, the result would probably be an increase in species richness and abundance as suspension feeders will thrive and moderate grazing by urchins will still occur opening space for new colonization. However, if wave exposure increased to extremely exposed or was similar to that present in a surge gulley, a small number of species (especially colonial ascidians) may become dominant and displace other species. Any increase in wave exposure may mobilize nearby cobbles, pebbles or sand abrading at least the lower parts of the biotope near to the mobile substrata and reducing species richness to tolerant or fast growing species. Overall, intolerance is indicated as low but could be not sensitive* in some situations and high in others. For recoverability, see Additional information below.
Wave exposure changes - local decrease	The biotope occurs in wave exposed situations. In a location where a decrease in wave exposure was from exposed to sheltered or very sheltered, the result would probably be a decrease in species richness and abundance as suspension feeders thrive in moderately strong wave action. However, if wave exposure decreased from extremely exposed, additional species may colonize the biotope. Any decrease in wave exposure may reduce mobility of nearby cobbles, pebbles or sand reducing abrasion. Overall, intolerance is indicated as not sensitive* bearing in mind that the biotope is found in exposed and moderately exposed situations and would most likely remain the same biotope.
Water clarity increase	Decrease in turbidity may lead to colonization of the biotope with some algal species. However, since the biotope is in shaded situations, the algae are likely to occupy little space and not displace animal species. For recoverability, see Additional information below.
Water clarity decrease	The community is animal dominated and characterized so that reduction in light levels as a result of increased turbidity is not relevant. The biotope appears to thrive in moderately high turbidity conditions - for instance in North Devon (K. Hiscock, own observations). For recoverability, see Additional information below.
De-oxygenation	The biotope and similar biotopes is found in full salinity. Several species in the biotope are likely to be adversely affected by lowered salinity including bryozoans and echinoderms especially. For recoverability, see Additional information below.
Nutrient enrichment	A slight increase in nutrient levels could be beneficial for suspension feeding species in the biotope by promoting growth of phytoplankton and therefore increasing food supplies. Indeed, *Balanus crenatus* was the dominant species on pier pilings, which were subject to urban pollution (Jakola & Gulliksen, 1987). Although increased nutrients may cause algae to thrive and smother species, this biotope is shaded and algal increase is not likely to be relevant.
Habitat structure changes - removal of substratum (extraction)	The majority of characterizing and dominant species in this biotope are fixed to the substratum and, therefore, will be removed with the substratum. Intolerance is therefore high. For recoverability, see Additional information below.
Heavy abrasion, primarily at	Erect epifaunal species are particularly vulnerable to physical disturbance. Hydroids and bryozoans are likely to be removed or damaged by bottom trawling or dredging (Holt et al., 1995). Veale et al. (2000) reported that the

the seabed surface	abundance, biomass and production of epifaunal assemblages decreased with increasing fishing effort. Hydroid and bryozoan matrices were reported to be greatly reduced in fished areas (Jennings & Kaiser, 1998 and references therein). The removal of rocks or boulders to which species are attached by the passage of mobile fishing gears (Bullimore, 1985; Jennings & Kaiser, 1998) results in substratum loss (see above). Magorrian & Service (1998) reported that queen scallop trawling removed emergent epifauna from horse mussel beds in Strangford Lough. They suggested that the emergent epifauna such as *Alcyonium digitatum* were more sensitive than the horse mussels themselves and reflected early signs of damage. However, *Alcyonium digitatum* is more abundant on high fishing effort grounds suggests that this seemingly fragile species is more resistant to abrasive disturbance than might be assumed (Bradshaw et al., 2000), presumably owing to good recovery due to its ability to replace senescent cells, regenerate of damaged tissue and early larval colonization of available substrata. Epifaunal ascidians are also likely to be removed by physical disturbance. Overall, physical disturbance by mobile fishing gear or equivalent force, is likely to remove a proportion of all groups within the community and attract scavengers to the community in the short term. Therefore, an intolerance of high has been recorded. Recoverability is likely to be high due to repair and regrowth of hydroids and bryozoans and recruitment within the community from surviving colonies and individuals (see additional information below). Severe physical disturbance will be similar in effect to substratum loss (see above).
Light abrasion at the surface only	
Siltation rate changes	The most likely smothering event in this habitat is by other species, for instance, a dense settlement of a colonial ascidian over other species. Some existing species such as barnacles are likely to be killed as access to food and oxygen will be denied. Others, such as erect Bryozoa and Hydrozoa will protrude above the smothering. Since the community will be partially destroyed and the diversity reduced, intolerance is considered intermediate. For recoverability, see Additional information below.
	The species present in the biotope are mainly passive and active suspension feeders perhaps benefiting from suspended organic matter with the suspended sediment but also possibly adversely affected by clogging of feeding organs by increase in siltation. Overall, it is likely that minor adverse effects will occur due to clogging of feeding organs. Species are unlikely to be killed during high suspended sediment of one month or so and recovery will be of condition only.
	The species present in the biotope are mainly passive and active suspension feeders feeding on planktonic organisms, perhaps benefiting from suspended organic matter with the suspended sediment. There might therefore be slightly less food but the adverse effects of silt clogging feeding organs would be removed so, on balance, no adverse effect is likely.
Introduction or spread of non-indigenous species.	No information found.

Introduction of microbial pathogens	The biotope is characteristic of locations where water movement is vigorous and oxygenation high. However, where that water movement is brought about by wave action, periods of still weather could cause de-oxygenation at least in the enclosed part of the biotope. Effects of hypoxia have been observed in nooks and crannies of this biotope with species dead and decomposing (K. Hiscock, personal observations).
Removal of target habitat	There are no current non-native species that are known to occur in this biotope. However, future arrivals may include species that could dominate the habitat and displace native species.
Removal of non-target habitat	It is extremely unlikely that any of the species indicative of sensitivity would be targeted for extraction. However, potting for lobsters often occurs in this habitat and the action of laying and pulling the pots may scrape the surface of the rock (see Physical Disturbance above for further details. This may lead to the loss of various individuals since the majority of fauna associated with this biotope are sessile epifauna. An intolerance of intermediate has been suggested with a high recovery (see additional information).

2.21	*Sabellaria alveolata* MLR.Salv
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	*Sabellaria alveolata*, the key structural species is intermediately intolerant of short term acute decreases in temperature. Variability in recruitment of *Sabellaria alveolata* (dependent on suitable environmental conditions) means that recovery could take a few years. The presence of some remaining adult worms will assist in *Sabellaria alveolata* larval settlement as this is the preferred substratum (Wilson 1929).
Salinity changes - local increase	*Sabellaria alveolata* inhabits fully marine environments and has intermediate intolerance to decreases in salinity. The species must though be able to tolerate some variation in salinity due to exposure to precipitation in the intertidal.
Water flow (tidal current) changes - local increase	Decreases in water flow rate will result in lower levels of suspended sediment and intermediate intolerance for *Sabellaria alveolata* but will have no effect on *Fucus serratus* or *Littorina littorea*. Increases in water flow may benefit *Sabellaria alveolata* but be detrimental for the other important species.
Emergence regime changes - local increase	The key structural species *Sabellaria alveolata* is intermediately intolerant of increases in emergence. *Fucus serratus* occurs in a fairly specific zone on the lower shore. Increases in emergence will probably result in high intolerance of this seaweed. Lower densities of algae growing on *Sabellaria alveolata* reefs may increase the time that the reef remains intact before being broken up through wave action. Loss of the seaweed will have consequential effects such as the loss of other species using the weed as substratum, including *Littorina littorea*. *Sabellaria alveolata*, the key structural species has moderate recoverability.
Wave exposure changes - local increase	Increases in wave exposure cause high intolerance in *Fucus serratus* and intermediate intolerance in *Littorina littorea* and *Sabellaria alveolata*. Variability in recruitment of *Sabellaria alveolata* (dependent on suitable environmental conditions) means that recovery could take a few years. The presence of some remaining adult worms will assist in *Sabellaria alveolata* larval settlement as this is the preferred substratum (Wilson, 1929). Recoverability of both the seaweed and the snail is high.
Water clarity decrease	*Fucus serratus* and *Littorina littorea* have low intolerance to increases in turbidity. Recoverability and restoration of condition should occur in less than six months.
Habitat structure changes - removal of substratum (extraction)	All the key and important species in the biotope exhibit high intolerance to substratum loss. *Sabellaria alveolata*, the key structural species has moderate recoverability.
Heavy abrasion, primarily at the seabed surface	Cunningham et al. (1984) examined the effects of trampling on *Sabellaria alveolata* reefs. The reef recovered within 23 days from the effects of trampling, (i.e. treading, walking or stamping on the reef structures) repairing minor damage to the worm tube porches. However, severe damage, estimated by kicking and jumping on the reef structure, resulted in large cracks between the tubes, and removal of sections (ca 15x15x10 cm) of the structure (Cunningham

Light abrasion at the surface only	et al., 1984). Subsequent wave action enlarged the holes or cracks. However, after 23 days, at one site, one side of the hole had begun to repair, and tubes had begun to extend into the eroded area. At another site, a smaller section (10x10x10 cm) was lost but after 23 days the space was already smaller due to rapid growth. Cunningham et al. (1984) reported that *Sabellaria alveolata* reefs were more tolerant of trampling than expected but noted that cracks could leave the reef susceptible to erosion and lead to large sections of the reef being washed away. However, eroded sections can survive and may lead to colonization of previously unsettled areas. The strange sculpturing of colonies in some areas is probably due to a combination of erosion and recovery (Cunningham et al., 1984). Continuous trampling may be more detrimental. For example, Holt et al. (1998) reported that, in Brittany, damage to reefs on popular beaches was limited to gaps created by trampling through the reef. Once gaps are formed, they may be enlarged by wave action. The main cause of colony destruction is through wave action. Cunningham et al. (1984) also noted that collection of *Sabellaria alveolata*, although a rare occurrence, may be particularly damaged as it will involve removal of sections of the reef. Trampling has been reported to reduce fucoid cover (Holt et al., 1997). Similarly, littorinids will be probably displaced and very occasionally crushed by trampling, although at the population level the effects are probably minimal. Therefore, trampling and other physical disturbance can potentially remove a proportion of the reef and an intolerance of intermediate has been recorded. Variability in *Sabellaria alveolata* recruitment (dependent on suitable environmental conditions) means that recovery could take a several years. The presence of remaining adults will assist in larval settlement, as this is the preferred substratum (Wilson, 1929). Therefore recoverability has been assessed as high.
Siltation rate changes	*Sabellaria alveolata*, the key structural species has only low intolerance to smothering. Wilson (1971) reported Sabellaria reefs surviving burial for a few days or even weeks. However, the important structural (*Fucus serratus*) and functional species (*Littorina littorea*) are both highly intolerant. Both *Sabellaria alveolata* and *Fucus serratus* are likely to recover from smothering within a few years.
	The intermediate intolerance of the functional grazing species *Littorina littorea* means that siltation may indirectly cause increased growth of algae on *Sabellaria alveolata* reefs, contributing to their more rapid breakdown through water action. Variability in recruitment of *Sabellaria alveolata* (dependent on suitable environmental conditions) means that recovery could take a few years. The presence of some remaining adult worms will assist in *Sabellaria alveolata* larval settlement as this is the preferred substratum (Wilson, 1929).
Visual disturbance	None of the selected important or characterizing species in the biotope are recorded as sensitive to visual presence.
Introduction or spread of non-indigenous species.	Insufficient information
Introduction of microbial pathogens	*Sabellaria alveolata* has intermediate intolerance to decreases in oxygenation. Cole et al. (1999) suggest possible adverse effects on marine species below 4 mg/l and probable adverse effects below 2mg/l. There is no information about

	Sabellaria alveolata tolerance to increases in oxygenation.
Removal of target habitat	Insufficient information
Removal of non-target habitat	Extraction of *Sabellaria alveolata* by bait digging is a possibility. *Fucus serratus* and *Littorina littorea* are also subject to extraction. Bait digging for other species, su ch as crab s, that live within cre vices and cracks o f *Sabellaria alveolata* reefs (as has been noted to occur in Portugal) may cause damage to other species in the biotope. Overall, it is more than likely that individuals of each species will remain and intolerance has been assessed as intermediate. Recovery is likely to be high.

2.22	***Sabellaria spinulosa* SS.SBR.PoR.SspiMx**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	SS.SBR.PoR.SspiMx is a circalit toral biotop e and, therefore, it is not accustomed to acute or rapid changes in temp erature. However, many of the associated fauna, including *Sabellaria spinulosa*, *Dendrodoa grossularia*, *Pomatoceros triqueter* and *Balanus crenatus* can be found intertidally and may be tolerant of acute increase s in temperature. Furt hermore, *Sabellaria spinulosa* occurs in the Mediterranean and is likely to be t olerant of a chronic increase in temperature although it is generally f ound in colder waters around in Atlantic a nd Arctic. However, so me of the epifauna may be intolerant to chronic in creases in te mperature. *Balanus crenatus* for example has been assessed as highly into lerant to a chronic increase in temp erature. In Queens Dock, Swan sea where t he water was on avera ge 10°C hig her than average due to the e ffects of a condenser ef fluent, *Balanus crenatus* was repla ced by the subtrop ical barna cle *Balanus amphitrite*. After the water temperature cooled *Balanus crenatus* returned (Naylor, 196 5). Although the loss of this species wo uld not affect the recognizable b iotope, intolerance has been assessed as intermediate to reflect the likely loss of some species. Recovery is expected to be high.
Temperature changes - local decrease	SS.SBR.PoR.SspiMx is a circalit toral biotop e and, therefore, it is not accustomed to acute or rapid changes in temp erature. However, many of the associated fauna, including *Sabellaria spinulosa*, *Dendrodoa grossularia*, *Pomatoceros triqueter* and *Balanus crenatus* can be found intertidally and may be tolerant of acute increases in temperature. *Sabellaria spinulosa* did not appear to suffer mortality during the 1963- 64 winter (Crisp, 1964 a). The species occurs north to the arctic, as does *Balanus crenatus*, and is therefore considered tolerant of decrease in t emperature. Alcyonidium digitatum can be found as far north as I celand. However, *Pomatoceros triqueter* can not build tubes below 7°C (Thomas, 1940) which, althou gh will not cause the de ath of the existing population, will mean that subsequent recruitment ma y fail. However, this will not affect the recognizable biotope and an intolerance of low has been suggested with a very high recovery (see additional information).
Salinity changes - local increase	SS.SBR.PoR.SspiMx is a circalittor al biotope f ound in full salinity habitats. An increase in salinity at the benchmark level is, therefore, highly unlikely and not relevant has been suggested.
Water flow (tidal current) changes - local increase	SS.SBR.PoR.SspiMx has been recorded from areas with strong to moderately strong tidal streams (Connor et al. , 2004). An increase in flow rate t o very strong is likely to be detrimental to the biotope. The aggregation of *Sabellaria spinulosa* tu bes would probably be broken up and redistributed along with much of the infauna. As a result many of the s pecies would be at increased risk of pred ation from mobile epib enthic pred ators such as hermit cr abs and pycnogonids. Specie s t hat use the reef as a ' hard substr atum' such as th e bryozoa *Flustra foliacea* and *Alcyonidium diaphanum*, the baked bean ascidian *Dendrodoa grossularia* and dead man's fingers *Alcyonium digitatum* may be lost. Finer particles may be was hed away leaving a clean gravel. An impoverished communi ty is likely to be left and biotopes such as SS.SCS.CCS.Pkef may develop. If cobbles and pebbles be came mobile they

	would result in scour and the mortality of individuals. An intolerance of high has been suggested to reflect the possibility that the entire structure on which the biotope is based could be broken up and washed away.
Water flow (tidal current) changes - local decrease	A decrease in water flow rate could result in the biotope being subjected to negligible flow rates and, particularly in view of the turbid water conditions the biotope often occurs in, siltation and smothering. This is likely to be sufficient to reduce availability of suspended particles, therefore hindering growth and repair of the *Sabellaria spinulosa* tubes and tube-building species. A reduction in suspended sediment will also affect food availability for both suspension feeders and, after the sediment has settled, deposit feeders. SS.SBR.PoR.SspiMx has been assessed as being of high intolerance to a decrease in water flow rate since juvenile worms would be unable to build their tubes. The remaining worms would slowly perish through lack of food as would other suspension feeders, and mobile fauna including pycnogonids, crabs and amphipods would move away. Overall the recognizable biotope would be lost and there would be a major decline in species diversity. Recoverability is likely to be high (see additional information).
Emergence regime changes - local increase	An increase in emergence is not relevant to this circalittoral biotope.
Emergence regime changes - local decrease	An decrease in emergence is not relevant to this circalittoral biotope.
Wave exposure changes - local increase	SS.SBR.PoR.SspiMx has been recorded from sheltered to moderately exposed locations. The *Sabellaria spinulosa* reefs are found between ca 10-30 m and this depth may mitigate any adverse effects associated with increased wave action. A small increase in wave action is likely to resuspended some sediment and if fine organic particles are lost from the biotope this will mean a decrease in food availability for both suspension and deposit feeders. Coarser material may also be resuspended and this may scour erect bryozoans and possible the more fragile tubes of various epifauna. However, strong increases in wave exposure associated with storms will compromise the stability of the matrix of tubes and may break up the reef. In this case there would be a major decline in species richness and intolerance has been assessed as high. Recovery is likely to be high (see additional information).
Wave exposure changes - local decrease	A decrease in wave exposure at the benchmark level means that SS.SBR.PoR.SspiMx could experience extremely sheltered conditions and, particularly in view of the turbid water conditions the biotope often occurs in, siltation and smothering. Wave action may be required, in the absence of strong tidal flow, to suspend the coarse sand particles needed to build tubes. Reduced wave action may mean the population exists outside of its preferred conditions with insufficient water action to provide sand particles or food. Over the benchmark period the reduction in feeding opportunity for all suspension feeders may prove fatal and species richness is expected to decline greatly. Intolerance has been assessed as high. High levels of recruitment means that recovery could be quite high (see additional information).

Water clarity increase	A decrease in the availability of suspended particles is dealt with in 'Suspended sediment'. In terms of a decrease in light attenuation associated with a decrease in turbidity, SS.SBR.PoR.SspiMx is thought to be tolerant*. Phytoplankton growth is likely to be enhanced , therefore providing more food for the suspension feeders.
Water clarity decrease	*Sabellaria spinulosa* thrives in areas of turbid water and the high levels of suspended sediment are a requirement for tube building (see Suspended sediment). SS.SBR.PoR.SspiMx has only been recorded from turbid areas and the biotope has therefore been assessed as tolerant.
Habitat structure changes - removal of substratum (extraction)	*Sabellaria spinulosa* forms dense aggregations on the substratum and loss of substratum would, therefore, lead to loss of the biotope. An Environmental Statement by Civil & Marine (1994, cited in Anon, 1999r) reported that some dredged samples contained up to 60 % of *Sabellaria spinulosa* by volume. Where full reviews of the species indicative of sensitivity were available, the species had also been assessed as highly intolerant to substratum loss (see reviews) and it is likely that the baked bean ascidian would also be highly intolerant even though no review was available. Accordingly, intolerance has been assessed as high . The recovery of this biotope is intrinsically linked to the nature of the substratum. Dredging for aggregates will remove the more gravely sediment from the biotope. The result substrata will be finer and, because *Sabellaria spinulosa* is associated with sandy and gravely deposits (Seiderer & Newell, 1999), the substratum may be unsuitable for the worms. Also, because aggregate extraction usually occurs in deeper water (>30 m), the substratum rarely gets replaced (Seiderer & Newell, 1999). Recovery has been assessed as high because the biotope is normally found in turbid environments where the worm should be able to build tubes. However, a finer sediment substratum might be less stable meaning that only ephemeral aggregations of the worms, as opposed to established 'reefs' with a diverse associated fauna, may be found.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	Riesen & Reise (1982) revisited a sampling site in the Wadden Sea after more than 50 years and found that *Sabellaria spinulosa* reefs and the associated fauna had been destroyed by shrimp trawlers. The worm was previously the second most abundant species in the site but in 1980 none were found. Mussel beds or amphipod assemblages (including Bathyporeia sp., Scoloplos sp. and Balanus sp.) had replaced the reefs (Riesen & Reise, 1982; Reise & Schubert, 1987). Vorberg (2000) observed that *Sabellaria spinulosa* appeared to be relatively robust and that shrimp trawling could occur without causing visible damage (this study involved the reef being trawled 6 times). However, fragile epifauna including erect bryozoa, dead man's fingers and tube worms may absorb some of the force of the trawl to their detriment. Abrasion resulting from substratum (cobbles and pebbles) becoming mobile is likely to cause significant damage, especially to erect epifauna and soft bodied organisms such as the baked bean ascidian. Overall, intolerance has been assessed as intermediate. Recovery of the biotope from the benchmark level of disturbance is likely to be high (see additional information). Vorberg (2000) reported that regrowth on damaged sections of *Sabellaria spinulosa* reefs was significantly higher than on an undisturbed reef . However, Holt et al. (1998) stated that recovery of *Sabellaria spinulosa* reefs from loss due to bottom fishing was impossible whilst the disturbance continued. In the case of continued disturbance, the *Sabellaria spinulosa* would be unlikely to form significant aggregations and, as a result, would no longer be defined as a reef because

	the tubes would lose their ability to stabilize the sediment. This would also affect the associated fauna since the 'hard substratum' element provided by the reef would be lost. Species requiring hard substratum such as *Flustra foliacea*, *Alcyonidium diaphanum*, *Alcyonium digitatum*, *Balanus crenatus*, *Pomatoceros triqueter* and some tube-building species would be lost.
	SS.SBR.PoR.SspiMx occurs on areas with strong to moderately strong tidal streams and it is unlikely that smothering would affect the biotope for long. Feeding in suspension feeders may be interrupted temporarily but the water flow will soon 'clean' the excess sediment from the biotope. Some sediment may become trapped in the nooks and crevices of the reef and this is likely to be of benefit to deposit feeders and infauna. Depending on timing this may interfere with reproduction (in terms, for example, of larval settlement) although only temporarily. Collins (2003a; 2003b; 2005) reported that *Sabellaria spinulosa* reefs in Poole Bay were periodically inundated with large sand waves. Such sand waves may be tens of centimetres deep and may smother the reefs for many months (K. Collins, pers. comm.). Although the reef structure may remain, it is most likely that many of the polychaetes themselves, being deprived of oxygen and feeding opportunity, will perish. Accordingly, intolerance has been assessed intermediate. Collins (pers. comm.) has also reported that no *Sabellaria spinulosa* juveniles have been observed on the reef which will affect the ability of the reef to recover. However, providing the reef structure remains, recovery should occur within 5 years and has therefore been assessed as high (see additional information).
Siltation rate changes	SS.SBR.PoR.SspiMx is only found in very turbid areas due to the fact that *Sabellaria spinulosa* require sand grains with which to construct their tubes. For the Sabellaria, an increase in suspended sediment could facilitate tube construction and may result in increased populations. However, an increase in suspended inorganic sediment may also clog feeding apparatus although associated fauna are likely to be tolerant of this to a certain degree because of the turbid conditions within which they live anyway. Hill et al. (1997) demonstrated that *Alcyonium digitatum* sloughed off settled particles with a large amount of mucous. The baked bean sea squirt may experience some damage as a result of scour although this will not affect the viability of the biotope as a whole. Overall, tolerant has been suggested.
	Tube growth in *Sabellaria spinulosa* is dependent on the presence of suspended particles and a reduction in suspended sediment may hinder tube construction and/or may favour other species to compete successfully with *Sabellaria spinulosa*. Furthermore, the wealth of suspension feeding polychaetes, bivalves and echinodermata etc may experience a reduction in food availability (organic suspended sediment). Overall, a decline in population density of *Sabellaria spinulosa* seems likely and other species may experience a reduced scope for growth. Intolerance has been assessed as intermediate since although adults are unlikely to be killed, young recruits may have problems building their tubes and may subsequently perish. Although recovery would be high, it may not happen within one year (as it might for other factors) since a winter storm combined with a reduction in suspended sediment means that the worms may not be able to rebuild their tubes. Overall, sensitivity has been assessed as low.
Underwater noise changes	Some of the species associated with SS.SBR.PoR.SspiMx may respond to noise vibrations though, for example, retreating into their tubes, hiding in crevices or closing their shells (in the case of bivalves) although this is unlikely

	to adversely affect them and tolerant has been suggested.
Visual disturbance	SS.SBR.PoR.SspiMx is found in very turbid environments and visual presence at the benchmark level is unlikely to affect the associated community. Tolerant has been suggested.
Introduction or spread of non-indigenous species.	Insufficient information was available with which to assess the sensitivity of SS.SBR.PoR.SspiMx to microbial pathogens.
Introduction of microbial pathogens	Cole et al. (1999) suggest possible adverse effects on marine species below 4 mg/l and probable adverse effects below 2 mg/l. *Balanus crenatus* and *Alcyonium digitatum* have been assessed as highly intolerant to a reduction in oxygen concentration. No information was found on the intolerance of *Sabellaria spinulosa* to changes in oxygenation although the fact that the biotope occurs in areas with strong water flow means that the effects are likely to be mitigated. Insufficient information was available and no sensitivity assessment has been made.
Removal of target habitat	It is unlikely that the integrity of the SS.SBR.PoR.SspiMx will be threatened by the introduction of invasive or alien species and tolerant has been suggested.
Removal of non-target habitat	*Sabellaria spinulosa* is unlikely to be the target of extraction (for instance, for bait). Extraction of the species is unlikely although dredging may remove populations in some habitats. Fisheries for the pink shrimp *Pandalus montagui* and brown shrimps (*Crangon crangon*) (often associated with areas of *Sabellaria spinulosa* reefs) have been implicated in the loss or damage of reefs. However, Vorberg (2000) undertook experimental and observational studies that indicated only minor damage to tubes and rapid recovery as a result of shrimp fisheries. Nevertheless, populations, especially if as loose aggregations, may be displaced by mobile fishing gear and a precautionary intolerance of intermediate is suggested. Vorberg (2000) suggested that declines might be more associated with changing patterns of currents perhaps associated with construction, dredging and dumping (see Physical Disturbance). However, *Sabellaria spinulosa* reef areas are known to have suffered widespread and long lasting damage as a result of bottom fishing for (see Physical Disturbance) and intolerance has been recorded as intermediate. Recovery is likely to be high (see additional information).

2.23	**Seagrass IMS.Zmar**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Increased temperatures may encourage growth of epiphytes and ephemeral algae while important grazers such as *Hydrobia ulvae* and *Lacuna vincta* are intolerant of temperature change. Although *Zostera marina* is tolerant of sea temperatures between 5-30°C (Davidson & Hughes, 1998), temperature change which leads to increased algal growth before the grazers can recover will reduce primary productivity. Prolonged temperature change may result in smothering of *Zostera marina* and reduction in extent or loss of the seagrass bed. Temperatures on 25-30°C may lead to mortality, reduced photosynthetic rates and reduced growth (Nejrup & Pedersen, 2007). However at the benchmark level, the biotope is not likely to be severely affected, hence intolerance is rated low. Low temperatures of 5°C lead to reduced photosynthetic rates (by up to 75%) and growth, but are sub lethal (Nejrup & Pedersen, 2007). Frost can damage leaves, and the formation of ice can uproot rhizomes and lead to the erosion of surface sediments (Den Hartog, 1987). Recoverability is likely to be very high, resulting in a very low sensitivity ranking.
Salinity changes - local increase	*Zostera* sp. has a wide tolerance of salinity from 10 - 39 ppt (Davison & Hughes, 1998). Germination in *Zostera marina* occurs over a range of salinities. *Hydrobia ulvae* and *Lacuna vincta* are tolerant of wide range of salinities. Therefore biotope intolerance is deemed to be low. Recoverability is likely to be very high, resulting in a very low sensitivity recording. However, not all members of the community have been assessed and some species may be intolerant of changes in salinity.
Water flow (tidal current) changes - local increase	Seagrasses require sheltered environments, with gentle long shore currents and tidal flux. Where populations are found in moderately strong currents they are smaller, patchy and vulnerable to storm damage and blow outs. Increased water flow may also increase sediment erosion (see siltation above). Coastal developments which alter hydrology have been implicated in the disappearance of seagrass beds (Van derHeide et al., 2007). Populations present in moderately strong currents may benefit from decreased water flow rates. As such, intolerance is rated intermediate. Recoverability is likely to be moderate, hence a suggested sensitivity of moderate.
Emergence regime changes - local increase	Decreased emergence may allow the seagrass beds to extend further up the shore. Increased emergence will reduce the upper extent of the biotope. Hence intolerance is intermediate. Populations on the lower shore are likely to be highly intolerant of increases in emergence (see desiccation). Recoverability is likely to be high, resulting in a low sensitivity ranking.

Wave exposure changes - local increase	Seagrasses require sheltered environments, with gentle long shore currents and tidal flux. Where populations are found in moderately strong currents they are smaller, patchy and vulnerable to storm damage and blow outs. Even large areas may be severely damaged during heavy storms (Davidson & Hughes 1998). Increased wave exposure may also increase sediment erosion (see siltation above). Populations present in moderately strong currents may benefit from decreased water flow rates. Small patchy populations or recently established populations and seedlings may be highly intolerant of increased wave action since they lack an extensive rhizome system. Hence intolerance is high; recoverability is likely to be very low, if at all, resulting in a very high sensitivity rating.
Water clarity decrease	Light attenuation limits the depth to which *Zostera marina* can grow as light is a requirement for photosynthesis. Growth of both *Zostera marina* and its associated epiphytes is reduced by increased shading due to turbidity (Moore & Wetzel, 2000). Turbidity resulting from dredging and eutrophication caused a massive decline of *Zostera* populations in the Wadden Sea (Giesen et al., 1990; Davison & Hughes, 1998). Seagrass populations are likely to survive short term increases in turbidity, however a prolonged increase in light attenuation, especially at the lower depths of its distribution, will probably result in loss or damage of the population. Hence intolerance is deemed to be high. Once seagrass beds have been lost, it has been suggested that a high turbidity environment may be a resilient alternative stable state, preventing any recovery (Van derHeide et al., 2007). Therefore recoverability is very low, resulting in a very high level of sensitivity.
Habitat structure changes - removal of substratum (extraction)	Substratum loss will result in the loss of the shoots, rhizome and probably the seed bank of *Zostera marina* together with its associated biotope, thus intolerance is deemed to be high. Recoverability of *Zostera marina* will depend on recruitment from other populations. Although *Zostera marina* seed dispersal may occur over large distances, high seedling mortality and seed predation may significantly reduce effective recruitment. The slow or total lack recovery of *Zostera* populations since the 1920s - 30s outbreak of wasting disease suggests that, once lost, seagrass beds take considerable time to re-establish, if at all. Hence recoverability is very low, and resulting biotope sensitivity is very high. Reed and Hovel (2006), found that removal of 90% of the substrata (which included seagrass plant material both above and below ground) in large 16 m^2 plots resulted in a significant loss of diversity and abundance of the epifaunal community. It was also noted that species composition was significantly different. However in smaller plots, or with a lower level of substrate removal, there was no observed correlation between seagrass loss and reduction in density or diversity of epifaunal species. This suggests the biotope may be tolerant of some substrate removal up to a threshold level. A further example is provided by Pihl et al. (2006), who demonstrated that the biomass, density and number of fish species was greater in seagrass beds than adjacent areas of sediment from which beds had been lost. Juvenile cod density was reduced by 96% in areas that no longer contained seagrass.
Heavy abrasion, primarily at the seabed surface	Small scale sediment disturbance may stimulate growth and removal of small patches of sediment allows recolonization by seedlings (Davison & Hughes, 1998). However seagrasses are not physically robust, so activities such as trampling, anchoring, digging, dredging, power boat and jet -ski wash are likely to damage rhizomes and cause seeds to be buried too deeply to germinate

Light abrasion at the surface only	(Fonseca, 1992). Suction dredging for cockles in the Solway Firth removed *Zostera* in affected areas while *Zostera* was abundant in un-dredged areas (Perkins, 1988). Physical disturbance and removal of plants can lead to increased patchiness and destabilization of the seagrass bed, which in turn can lead to reduced sedimentation within the seagrass bed, increased erosion, and loss of larger areas of *Zostera* (Davison & Hughes, 1998). Therefore, the impact from a scallop dredge is likely to remove a proportion of the population and result in increased erosion of the bed. Hence, intolerance has been recorded as intermediate. Grazing gastropods and other epifauna are small but likely to be displaced or removed attached to the leaves of *Zostera*. Reduction in numbers of grazers may potentially result in smothering by growth of epiphytes and other algae, especially in the spring and summer months. Recovery is dependant on the size of the size of the area affected, so is set as moderate, yielding a moderate sensitivity rating.
Siltation rate changes	Sediment disturbance, siltation, erosion and turbidity resulting from coastal engineering and dredging activities have been implicated in the decline of seagrass beds world wide (Holt et al., 1997; Davison & Hughes, 1998). Seagrasses are intolerant of smothering and typically bend over with addition of sediment and are buried in a few centimetres of sediment (Fonseca, 1992). Epiphytes and macroalgae are also likely to be intolerant of smothering, hence intolerance is deemed high. Infaunal species within the community are unlikely to be intolerant of smothering itself. However, the community will probably be intolerant of loss of the source of primary production on substratum. Recoverability will depend on recruitment from other populations. Although *Zostera marina* seed dispersal may occur over large distances, high seedling mortality and seed predation may significantly reduce effective recruitment. The slow recovery of *Zostera* populations since the 1920s - 30s outbreak of wasting disease suggests that, once lost, seagrass beds take considerable time to re-establish. Thus recoverability is very low, and resulting sensitivity is very high.
	Increased sediment erosion or accretion have been associated with loss of seagrass beds in the Australia, the Mediterranean and USA (for example Bernard et al., 2007). Increased sediment availability may result in raised seagrass beds, more likely to be exposed to low tide, desiccation and high temperatures. Increases in suspended sediment may also increase sediment deposition, which could potentially lead to the smothering of beds (Portig et al., 1994) (see smothering, above). Seagrass beds demonstrate a balance of sediment accretion and erosion. Sediment deposited during summer months may be lost again due to winter storms, resuspension by grazing wildfowl, and increased erosion due to die back of leaves and shoots in autumn and winter (Ranwell et al., 1974). Seagrass beds should be considered intolerant of any activity that changes the sediment regime where the change is greater than expected due to natural events. When loss of seagrass beds is due to increased turbidity related to suspended sediment, recovery is may be impossible, probably because seagrass beds are required to initially stabilise the sediment and reduce turbidity levels (Van derHeide et al., 2007). A high turbidity state appears to be a highly resilient alternative stable state, hence return to the seagrass biotope is unlikely.

Underwater noise changes	The effect of sound waves and vibration on plants is poorly studied. It is likely that sound waves will have little effect on *Zostera marina* at the benchmark levels suggested, hence the biotope is deemed to be tolerant. However, fish species and grazing wildfowl are likely to be disturbed by noise at the benchmark level.
Visual disturbance	Continuous shading will affect photosynthesis and therefore viability. However, occasional shading caused by surface movements of vessels at the level of this benchmark is unlikely to have an effect on seagrass beds. Hence the biotope is deemed to be tolerant.
Introduction or spread of non-indigenous species.	A major outbreak of wasting disease resulted in significant declines of *Zostera marina* beds in 1920s to 1930s, so intolerance is recorded as high. Wasting disease is thought to be caused by the marine fungus, *Labyrinthula macrocystis*. The disease is less likely at low salinities. However, *Zostera marina* is often found in fully salinity waters. The disease causes death of leaves and, after 2-3 seasons, death of regenerative shoots, rhizomes and loss of up to 90 percent of the population and its associated biotope. Hence recoverability is very low, and sensitivity is very high.
Introduction of microbial pathogens	Loss of grazers due to low oxygen levels will result in unchecked growth of epiphytes and other algae which may smother *Zostera marina*. Therefore intolerance is intermediate. On return to normal conditions, recovery is likely to be rapid, so is assessed as high, resulting in a low sensitivity value. Prolonged deoxygenation is likely to damage the seagrass itself (Jones et al., 2000).
Removal of target habitat	*Spartina anglica* (a cord grass) is an invasive pioneer species, a hybrid of introduced and native cord grass species, which colonises the upper parts of mud flats. Its rapid growth consolidates sediment, raises mudflats and reduces sediment availability elsewhere. It has been implicated in the reduction of *Zostera* sp. cover in Lindisfarne, Northumberland due to encroachment and changes in sediment dynamics (Davison & Hughes, 1998). Japanese weed (*Sargassum muticum*) invades open substratum subtidally and may prevent recolonisation of areas of seagrass beds left open by disturbance (Davison & Hughes, 1998). *Zostera marina* and *Sargassum muticum* may compete for space in the lower shore lagoons of the Solent. *Sargassum muticum* is able to colonise soft sediments by attachment to embedded fragments of rock or shell (Strong et al., 2006). Further, it has been suggested by Tweedley et al. (2008) that the presence of *Zostera marina* beds may facilitate the attachment of *Sargassum muticum*. However, evidence for competition is conflicting and requires further research, hence an assessment of intermediate intolerance. If the invasive species prevent recolonisation then the recoverability from other factors will be reduced. Therefore recoverability is low, and sensitivity is assessed as high.

Removal of non-target habitat	Wildfowl grazing can consume significant amounts of seagrass and reduce cover mainly in autumn and winter. Grazing probably causes part of the natural seasonal fluctuation in seagrass cover and *Zostera* sp. can recover from typical levels of grazing. However, where a bed is stressed by other factors it may not be able to withstand grazing (Holt et al., 1997; Davison & Hughes, 1998). Seagrass rhizomes are easily damaged and the seagrass bed is unlikely to survive extraction. Seeds may be buried too deep to germinate. Mechanical dredging of cockles in the Solway Firth, in intertidal *Zostera* beds, resulted in the loss of the seagrass bed and was closed. Dredging for bivalves has been implicated in the decline of seagrass beds in the Dutch, Wadden Sea. Damage of *Zostera noltii* beds after the Sea Empress oil spill was reported as limited to the ruts left by clean up vehicles. Intolerance has been assessed as intermediate with a moderate recovery, resulting in a moderate sensitivity rating.

2.23	**Seagrass IMS.Rup**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The temperature regime is important for reproduction in *Ruppia* spp. Germination and budding begin when the water temperatures rise in early spring above a min/max of 10/15°C, with reproduction (flowering) commencing at 15-19°C but reproduction falls above 30°C . Therefore, the timing of growth and reproduction in *Ruppia* spp. are temperature dependant and are probably earlier in warm years and later in cold years. Optimum temperatures for vegetation growth was reported to be 12-13°C, and 15-20°C for seedlings, although local adaptation occurs (Verhoeven, 1979; Kantrup, 1991). Verhoeven (1979) noted that all *Ruppia* taxa survive between 0 -38°C, grow exponentially at 10 -30 °C and survive daily fluctuations of 15°C in culture. However, Kantrup (1991) suggested that temperatures above 30°C were probably harmful and noted that *Ruppia* spp. were replaced by *Potamogeton pectinatus* in the vicinity of a thermal effluent where temperatures sometimes reached 35 °C. Verhoeven (1979) concluded that *Ruppia* spp. were well adapted to the temperature conditions found in small shallow waters. Therefore, *Ruppia* spp. are probably not sensitive to temperature increase at the level of the benchmark. Species inhabiting lagoons and shallow lochs are probably adapted to fluctuating temperatures, while mobile species are likely to move to deeper waters. Benthic infauna are likely to be protected form temperature extremes by their benthic habit, however, a proportion of the *Arenicola marina* population may be lost at temperatures above 20 °C, and excluded from habitats suffering from more extreme fluctuations in temperature. Therefore, an increase in temperature at the benchmark level may not adversely affect the *Ruppia* spp. beds but is likely to result a reduction in species richness.

Temperature changes - local decrease	A decrease in temperature is likely to delay the onset of budding and germination and subsequent reproduction in *Ruppia* spp., which may be of particular importance for annual species (see above). Verhoeven (1979) noted that all *Ruppia* taxa survive between 0 -38°C, grow exponentially at 10 -30°C and survive daily fluctuations of 15°C in culture. Kantrup (1991) reported that in North American wetlands that freeze in winter, *Ruppia* spp. behaved as annuals. Verhoeven (1979) reported that the distribution of *Ruppia maritima* and *Ruppia cirrhosa* extended north to Norway (ca 69°N and 68°N respectively), suggesting that these species would be tolerant of the average winter temperatures encountered in the UK. Therefore, *Ruppia* spp. are probably not sensitive to temperature increase at the level of the benchmark. Many of the species found within the *Ruppia* spp. communities are typically lagoonal or shallow water species, adapted to fluctuating temperatures. Infaunal polychaetes are protected from temperature extremes by their burrowing habit, however, a proportion of the *Arenicola marina* population may be lost below 5°C on in areas subject to extreme fluctuations in temperature. Overall, the *Ruppia* spp. stand will not be damaged by a decrease in temperature at the benchmark level but some species will reduce in abundance while mobile species may move to deeper water resulting in a reduced species richness.
Salinity changes - local increase	*Ruppia* spp. tolerate a wider range of ionic strengths and salinities than any other aquatic angiosperm, occurring between 0.6 -390g/l (Kantrup, 1991). However, the reported salinity tolerances vary with region and with species. *Ruppia maritima* was reported to be abundant at salinities between 15 - >100g/l in North American wetlands and between 0.57 -27g/l in European sites (Verhoeven, 1979; Kantrup, 1991). *Ruppia cirrhosa* tolerated 2.7-108.3 g/l in European sites (Verhoeven, 1979). Kantrup (1991) concluded that the optimum salinity for *Ruppia* spp. Growth was 5-20 g/l while slightly lower salinities early in spring may enhance germination and seed formation. Rapid fluctuations were found to kill *Ruppia* spp. when salinities rise >ca18g/l in a few weeks (Verhoeven, 1979). However, *Ruppia* spp. was also reported to survive a drop of at least 14 g/l in 24 hrs (Kantrup, 1991). Overall, *Ruppia* spp. are probably not directly sensitive changes in salinity at the benchmark level. Their exclusion from very low to freshwater, or nearly full seawater is probably due to competitive exclusion by other aquatic plants or seagrasses. As the salinity increases low salinity species are likely to be replaced by comparable marine forms. Typically lagoonal species (e.g. the hydrobids, some gammarids, and *Cerastoderma glaucum*) are adapted to a wide range of salinities and are unlikely to be affected. Estuarine and low salinity polychaetes present in the benthos are likely to be replaced by more marine species as the salinity increases, e.g. the abundance of *Hediste diversicolor* is likely to fall while the abundance of *Arenicola marina* increases. Sticklebacks are found in marine and freshwater habitats and the sand goby tolerates a wide range of salinities. Therefore, the biotope as a whole will probably be little affected by increases in salinity at the benchmark level, although some species may be replaced by more marine members of the same group. As the salinity increased more marine species would be able to colonize the habitat so that the species richness may increase. Therefore, an intolerance of low has been recorded at the benchmark level. However, should the biotope be exposed to full salinity for a prolonged periods, the biotope may be replaced by seagrass species. Once prior conditions return, recovery is likely to be rapid (see additional

	information below).
Water flow (tidal current) changes - local increase	The IMS.Rup biotope is found in extremely sheltered conditions in very weak tidal streams. An increase in water flow at the benchmark level (i.e. from very weak to moderately strong) is likely to damage leaves and shoots and probably remove the vegetation and a proportion of the root system. The root system of *Ruppia* spp. is poorly developed consisting of horizontal runners a few mm below the sediment surface and only 1-2 thin roots per 10-20cm along the rhizome. Therefore, *Ruppia* spp. are not very resistant of water flow and are limited to still, sheltered waters such as lagoons and bays where current flow is less than in adjacent channels and tidal rivers (Verhoeven, 1979; Kantrup, 1991). Verhoeven (1979) suggested that *Ruppia maritima* was particularly intolerant while *Ruppia cirrhosa* occurred in larger waters at more exposed but still sheltered sites. In addition, turbulent water flow resulting in resuspension of sediment can indirectly reduce *Ruppia* productivity due to increased turbidity (see below). Kantrup (1991) reported that *Ruppia* spp. can occur in areas of 'considerable' current flow, e.g. *Ruppia* beds fertilized in situ with phosphorus were found to grow well in currents up to 4cm/s. However, 4cm/s is considered to be negligible (see benchmark). Epiphytes and algal mats would also be lost. Therefore, an intolerance of high has been recorded. Most of the benthic infauna are found in areas of stronger currents (e.g. *Arenicola marina*), and many of the mobile species (e.g. amphipods, isopods, shrimp, crabs and fish) would migrate to other suitable substrata or habitats. However, where present *Cerastoderma glaucum* is only found in areas of weak water flow and may be lost. Recovery will depend on recolonization by *Ruppia* spp. propagules (rhizomes or seed), which may take many years (see additional information). However, the associated community of epiphytes and invertebrates will probably colonized re-established *Ruppia* stands rapidly.
Water flow (tidal current) changes - local decrease	This biotope occurs in very weak tidal streams. A decrease in water flow will result in negligible flow. Kantrup (1991) suggested that stable water provided good growing conditions for *Ruppia* spp. However, negligible water flow increases deposition of fine, flocculent muds and clays, and the potential for deoxygenation of the water column or sediment, which may reduce *Ruppia* productivity. Therefore, an intolerance of low has been recorded, at very low confidence.
Emergence regime changes - local increase	*Ruppia* dominated communities can occur in tidal areas, from mean high to mean low water. It was reported to be common or restricted to intertidal areas exposed for 4hrs daily or 6.96hrs per low tide but quickly disappeared from areas emersed for longer periods (Kantrup, 1991). Therefore, while *Ruppia* spp. are relatively tolerant of fluctuating water levels an increase in emergence within tidal *Ruppia* beds is likely to result in reduced growth, production and the loss of the upper portion of the population, especially on hot sunny days. An increase in emergence in a normally submerged bed may have only sublethal effects. Hydrobia spp. inhabit salt marshes and are tolerant of emersion. Gammarids and isopods either migrate to deeper water, burrow in the sediment of shelter in damp weed to avoid the effects of emergence. Algal mats retain water, and while their surface may be bleached or desiccate in hot sunny weather, they are likely to recover quickly. *Arenicola marina* and *Pygospio elegans* together with several bivalve species recorded in the biotope occur in the intertidal and would probably tolerate an increase in emergence at the benchmark level. However, where present, *Cerastoderma glaucum* is

	thought to be intolerant of changes in emergence and may be lost. Overall, an increase in emergence may result in a reduction in the upper shore extent of the *Ruppia* spp. bed and some intolerant species may be lost. Therefore, a biotope intolerance of intermediate has been recorded. Recolonization by *Ruppia* spp. and its associated community will probably occur from the surrounding communities and via the remaining seed bank and is likely to be rapid (see additional information below). Therefore a recoverability of high has been suggested.
Emergence regime changes - local decrease	In shallow subtidal areas a decrease in emergence may increase the relative water depth, increasing light attenuation and reducing growth and productivity. However, in deeper water the growth form of *Ruppia* spp. produces longer stems and concentrates the leaves higher in the water column (Kantrup, 1991). An increase in immersion may allow intertidal stands of *Ruppia* to colonize further up the shore and increase in extent. Therefore, decreased emergence is likely to have only sublethal effects and may allow the population to increase in extent, therefore not sensitive* has been recorded.
Wave exposure changes - local increase	Kantrup (1991) reported that wave action damaged *Ruppia* plants stems and leaves and Verhoeven (1979) noted that the base of leaves detached easily in turbulent water to avoid damage to the root system. However, the root system is weak (see water flow) and *Ruppia* beds are restricted to areas protected from wave action and with little fetch and wind induced water turbulence. Wave action also resuspends sediment, increasing turbidity and hence reducing productivity. This biotope (IMU.Rup) is found in extremely sheltered areas, therefore, and increase in wave action at the benchmark level is likely to remove the surface vegetation and the majority of the root system. Most lagoonal species are adapted to sheltered conditions and are likely to be adversely effected by increases in wave exposure, e.g. *Gammarus insensibilis* and *Cerastoderma edule*, at the benchmark level resulting in loss of a proportion of the population. The resident gastropods e.g. *Hydrobia ulvae* are unlikely to be directly affected, and will switch to alternative food supplies, however, should the increase in wave exposure be significant enough to change the sediment type, e.g. to coarse sands, they are likely to be lost. Benthic species, such as *Arenicola marina* can tolerate sheltered to moderately exposed conditions and would probably be little affected at the benchmark level. Overall, therefore, although most of the benthic infauna will remain, loss of the *Ruppia* stands will result in loss of its associated epiphytic flora and fauna and the biotope as a whole. Therefore, an intolerance of high has been recorded.
Wave exposure changes - local decrease	This biotope occurs in extremely sheltered condition and any further decrease in wave exposure, i.e. to ultra sheltered is unlikely to have an adverse affect, although the risk of anoxia may be increased (see below).
Water clarity increase	*Ruppia* spp. beds are likely to occur in clear waters, however, any further decrease in turbidity is likely to increase productivity and seed set and may allow the *Ruppia* spp. bed to extend its range. Therefore, the biotope and its associated community is likely to benefit.
Water clarity decrease	*Ruppia* spp. require high light levels and only normally develop well in clear water and are always reduced or absent from turbid waters (Verhoeven, 1979). Increased turbidity results from increases in dissolved organics (e.g. humic

	acids or gelbstoff), organic particulates and suspended sediment (see above), or blooms of phytoplankton and zooplankton (see nutrients below). Large beds of *Ruppia* spp. were reported to have disappeared due to rapid increases in turbidity (Anderson, 1970; cited in Kantrup, 1991). *Ruppia* spp. beds may tolerate occasional turbid events, e.g. from storms or flooding but grow sparsely in turbid waters (Richardson, 1990; cited in Kantrup, 1991). A 40% reduction in light intensity was reported to result in a 50% reduction in *Ruppia* spp. Standing crop (Congdon & McComb, 1979; cited in Kantrup, 1991). Kantrup (1991) concluded that control of water clarity was of utmost importance to establish or maintain *Ruppia* spp. beds. Loss of the *Ruppia* vegetation would result in loss of substratum, refuge, productivity, and the associated community. Benthic infauna would loose a significant source of primary productivity but would likely survive in the absence of *Ruppia* spp. The *Ruppia* spp. bed may be replaced by Potamogeton species in low salinity habitats. Overall, the biotope is likely to be lost an intolerance of high has been recorded. Recovery will depend on recolonization by *Ruppia* spp. propagules (rhizomes or seed), which may take many years (see additional information below). Therefore a recoverability of moderate has been recorded.
Habitat structure changes - removal of substratum (extraction)	Removal of the substratum would remove *Ruppia* spp. and their associated epiphytes and invertebrates, together with roots, rhizomes and the seed bank. Therefore, an intolerance of high has been recorded. Recovery will depend on recolonization by *Ruppia* spp. propagules (rhizomes or seed), which may take many years (see additional information). However, the associated community of epiphytes and invertebrates will probably colonized re-established *Ruppia* stands rapidly.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	*Ruppia* stems and leaves are damaged by wave action or water turbulence and the root system is shallow and weak (Verhoeven, 1979; Kantrup, 1991). Therefore, it is likely that *Ruppia* spp. are intolerant of physical disturbance and that a proportion of the vegetation may be removed and rhizomes broken by anchorage or mooring (see benchmark). Benthic infauna such as polychaetes (e.g. *Arenicola marina* or *Pygospio elegans*) are partly protected from abrasion due to their infaunal habit but a proportion are likely to be killed by any mechanical disturbance that penetrates the sediment (e.g. anchors). Similarly, the shell of *Cerastoderma glaucum* is relatively thin and individuals are likely to be damaged or killed by abrasion. Macroalgae and relatively flexible and unlikely to be damaged. However, resident grazers (e.g. gammarid amphipods, isopods, or gastropods) are likely to be killed by direct physical contact, although they are generally small enough to be swept aside, or able swimmers and most will probably escape. Overall, a proportion of the *Ruppia* beds will be removed, together with a proportion of the associated community and benthic infauna. Therefore, an intolerance of intermediate has been recorded. The *Ruppia* beds will probably recover relatively rapidly from the surrounding plants, the seed bank and fragments of rhizome remaining in the sediment.

	Ruppia spp. probably traps sediment and increases accretion rates, although little information on accretion rates in *Ruppia* beds was found. Smothering by 5cm of sediment will shade and damage buried leaves and stems resulting in loss of a proportion of the vegetation above the sediment surface, including the algal mats and epiphytes. Kantrup (1991) suggested that, although most seeds occur in the top 5cm of sediment, seeds buried more than 10cm in sediment would probably not germinate, so that smothering by 5cm of sediment may reduce germination. Smothering in early spring may have a marked effect of the growth of *Ruppia* spp. stands, especially annuals that are primarily dependant on seed. Most members of the invertebrate fauna will probably be able to burrow through or avoid smothering. However, some hydrobid snails may be lost due to smothering and cockles (Cerastoderma sp.) have limited ability to burrow and may be adversely affected. Therefore, an overall intolerance of intermediate has been recorded. After a month (the benchmark level) the *Ruppia* stand and its associated community will probably recover rapidly (see additional information below).
Siltation rate changes	Tidal waters with dense stands of *Ruppia* spp. were usually clear in the growing season but occasionally turbid with sediment due to storms or flooding. However, areas which consistently carried suspended sediment supported only sparse growth (Robertson, 1980; cited in Kantrup, 1991). *Ruppia* spp. has been recorded from waters containing 17.5-42.5 ppm suspended sediment and wetlands are recommended to be managed within 25 -55 ppm suspended sediment for *Ruppia* spp. cultivation (Kantrup, 1991). Therefore, an increase in suspended sediment at the benchmark level is likely to have a significant effect. The most important effect of increased suspended sediment on *Ruppia* spp. is increased turbidity and light attenuation and is addressed under turbidity below. Increased accretion in shallow water habitats could increase the bed height, which would bring the *Ruppia* bed closer to light. However, in the longer term, increased sedimentation may result in drying of the shallowest parts of the beds and replacement of the *Ruppia* beds with a hydrosere of reeds, sedge or other saltmarsh species. Most other members of the community are probably tolerant of increased suspended sediment since they inhabit estuarine or lagoonal habits where periodic resuspension of sediment or siltation occur. Overall, therefore, increased suspended sediment is may result in loss of a proportion of the *Ruppia* beds either due to succession or drying and an intolerance of intermediate has been recorded. Recovery will depend of recolonization from the established bed and of associated species from the surrounding area, and is likely to be rapid (see additional information below).
	Little information concerning accretion or erosion rates in *Ruppia* beds was found. Decreased suspended sediment concentration will increase water clarity and hence growth, seed set and productivity in *Ruppia* spp. and the associated algal communities. Overall, the community is likely to benefit. However, seagrass beds are know to depend on a balance between accretion and erosion, and to be intolerant of changes in sedimentation rates, which depend in part on suspended sediment levels (see IMS.Zmar). Therefore, a decrease in sedimentation that results in net erosion of the sediment is likely to result in loss of *Ruppia* spp. stands.

Underwater noise changes	The majority of species in *Ruppia* dominated communities are unlikely to react to noise at the benchmark level. Wildfowl, however, are intolerant of disturbance from noise from e.g. shooting (Madsen, 1988) and from coastal recreation, industry and engineering works. For example, Percival & Evans (1997) reported that wigeon were very intolerant of human disturbance and, where wildfowling was popular, wigeon avoided *Zostera noltii* beds at the top of the shore.
Introduction or spread of non-indigenous species.	Kantrup (1991) reported possible pathogenic effects of fungi that produce 'tubercles' on the *Ruppia* leaves. Kantrup (1991) also states that 'vegetative reproduction usually allows *Ruppia* spp. to survive Rhizoctonia infestations' and that *Ruppia* spp. probably suffer less from diseases than other aquatic angiosperms.
Introduction of microbial pathogens	*Ruppia* spp. favour aerobic sediments with low levels of sulphides and free H_2S but will grow in reduced conditions, since the leaves supply oxygen to the roots. Senescence and loss of stems can coincide with increases in H_2S in the sediment and may be a factor regulating the decrease in *Ruppia* species in hot summer months (Kantrup, 1991). Germination may also be affected by oxygen levels and seeds in poorly oxygenated sediments lie dormant until the next year (Kantrup, 1991). However, the presence of *Ruppia* in reduced sediment suggests that it would tolerate low oxygen levels comparable to the benchmark, especially since photosynthesis produces oxygen. Mud snails (hydrobids) are relatively tolerant of reduced hypoxic muds, and can tolerate aerial exposure for over a week, suggesting that they are capable of anaerobic respiration. Benthic infaunal species are probably tolerant of hypoxia, e.g. *Arenicola marina* which can tolerate 9 days without oxygen (Hayward, 1994) and *Cerastoderma glaucum* which tolerates 84 hrs in the absence of oxygen (Boyden, 1972). Most polychaetes are capable of anaerobic metabolism, while mobile fish and gobies migrate out of the affected area in response to decreasing oxygen levels (Diaz & Rosenberg, 1995). Small mobile shrimp, amphipods and isopods will probably also migrate out of the affected area. Therefore, the *Ruppia* stands and benthic infauna will probably tolerate hypoxia at the level of the benchmark and an intolerance of low has been recorded, since increased epiphyte growth due to reduced numbers but not loss of grazers, may reduce *Ruppia* spp. productivity. However, species richness is likely to decline. Recovery is likely to be rapid (see additional information below).
Removal of target habitat	No information found.

Removal of non-target habitat	*Ruppia* spp. is not subject to any specific extraction within the UK. However, in subtropical areas wintering wildfowl were reported to consume entire stands of *Ruppia* spp. which grew back in a few weeks (Kantrup, 1991). Similarly, Steiglitz (1966, cited in Kantrup, 1991) suggested that wildfowl could consume 50% of the standing crop without damaging the *Ruppia* bed. This evidence suggests that *Ruppia* stands would tolerate grazing and possibly extraction although a proportion of the algal mats and the associated invertebrate fauna would be removed. Therefore, an intolerance of intermediate has been recorded at the benchmark level. Recovery is likely to be rapid (see additional information below). Extraction of *Arenicola marina* for bait is likely to disturb the sediment and benthic infauna, although the *Ruppia* stands themselves would probably recover quickly (see above). Similarly, *Arenicola marina* populations are thought to recover rapidly, although in isolated areas recovery may take longer due to the lack of a pelagic larvae. Intolerance has been assessed as intermediate.

2.24	**Sea-pen and burrowing megafauna communities CMU.SpMeg**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	In shallow sea lochs, sedimentary biotopes typically experience seasonal changes in temperature of about 10° C and so CMU.SpMeg may be tolerant of long term increases although growth and fecundity of some species may be affected. No information was found on the upper limit of sea pens tolerance to temperature increases. However, the distribution of the sea pens typically found in the biotope, *Virgularia mirabilis*, *Pennatula phosphorea* and *Funiculina quadrangularis*, extends south into the warmer waters of the Mediterranean suggesting they may be able to tolerate a long term increase in temperature of 2°C. However, sea pens are subtidal animals where wide and rapid variations in temperature, such as experienced in the intertidal, are not so common and so may be more intolerant of a short term increase of 5°C. The reported intolerance to changes in temperature for *Virgularia mirabilis* is intermediate. Since the loss of sea pens changes the biotope the intolerance of the biotope to increased temperature is also recorded as intermediate. For most deep burrowing species temperature changes in the water column are likely to be buffered to some extent by the sediment and so many individuals will not be affected. See additional information for details of recovery.
Temperature changes - local decrease	In shallow sea lochs, sedimentary biotopes typically experience seasonal changes in temperature of about 10° C and so CMU.SpMeg may be tolerant of long term decreases although growth and fecundity of some species may be affected. No information was found on the lower limit of sea pens tolerance to temperature decreases. However, the distribution of the sea pens typically found in the biotope, *Virgularia mirabilis*, *Pennatula phosphorea* and *Funiculina quadrangularis*, extends into the northern North Atlantic where waters are colder than in the UK suggesting they may be able to tolerate a long term decrease in temperature of 2°C. However, sea pens and other species in the biotope are subtidal where wide and rapid variations in temperature, such as experienced in the intertidal, are not so common and so may be more intolerant of a short term decrease in temperature of 5°C. For most deep burrowing species temperature changes in the water column are likely to be buffered to some extent by the sediment and so many individuals will not be affected. During the very cold winter of 1962-63 a few dead *Nephrops norvegicus* were caught in the North Sea although the majority were caught alive (Crisp, 1964) therefore it seems likely that burrowing species will probably be not sensitive to the factor. Since one of the key faunal groups, the sea pens may be intolerant of a short term decrease and the viability of populations may be threatened the intolerance of the biotope to decreased temperature is recorded as intermediate. See additional information for details of recovery.
Salinity changes – local increase	The biotope is found in fully marine conditions so is likely to be intolerant of increases in salinity. The overall effect on the biotope of a chronic decrease in salinity for a period of a year is likely to be the loss of most species and so intolerance is reported as high. Recovery is likely to take longer than five years and has been recorded as moderate (see additional information).

Water flow (tidal current) changes - local increase	The biotope is found in areas of weak or very weak tidal streams and so is likely to be intolerant of increases in water flow. Strong tidal currents keep most of the organic particles in the sediment in suspension which can support suspension feeders even in low organic content sediments. The horizontal supply of small and light nutritious particles by resuspension and advective transport has been shown to influence the growth rate of suspension-feeding benthos (Dauwe, 1998). However, some suspension feeders in the biotope will be unable to feed if the water flow rate increases by two categories in the water flow scale (see benchmarks). The sea pen *Virgularia mirabilis* for example, will retract into the sediment at water currents speeds greater than 0.5m/s (i.e. 1 knot). If water speeds remain at this level or above, the sea-pen will be unable to extend above the sediment, unable to feed and will die. Increases in flow rate will change the surface layer of the sediment structure, removing the fine mud element to leave the coarser particles behind. A long term increase (i.e. the benchmark level of one year) will change the nature of the top layers of sediment, becoming coarser and possibly unsuitable for some shallow burrowing species such as the brittle stars *Amphiura*. Deeper burrowing species such as the thalassinidean crustaceans *Callianassa subterranea* and *Nephrops norvegicus* are not likely to be affected by sediment changes at the surface. The overall impact of an increase in water flow rate on the biotope may be the loss of some key species, such as sea pens, which changes the biotope, and some other species such as brittle stars and so intolerance is assessed as high. In slightly more energetic conditions and coarser sediment the biotope CMS.AfilEcor which includes *Callianassa subterranea* and sparse *Virgularia mirabilis* is more likely to be present. Recovery has been assessed as high (see additional information).
Water flow (tidal current) changes - local decrease	The biotope exists in habitats where tidal streams are already very weak so a decrease in flow rate would result in almost non-moving water. Tidal currents keep most of the organic particles in the sediment in suspension which can support suspension feeders even in low organic content sediments. Therefore, if water movement becomes negligible suspended organic particles available to filter feeders such as the sea pens will decline. Growth and fecundity will be affected and over a period of a year may result in the death of sea pens. In enclosed or semi-enclosed water bodies, such as sea lochs, negligible water flow may result in some deoxygenation of the overlying water and the loss of some intolerant species. The sea pen *Virgularia mirabilis* for example, has high intolerance to deoxygenation and may die. However, other species such as *Callianassa subterranea* and many other thalassinidean crustaceans are tolerant of reduced oxygenation and are not likely to die. The overall impact on the biotope is likely to be the loss of a few key species such as sea pens and so intolerance is assessed as high. Recovery has been assessed as high (see additional information).
Emergence regime changes	The biotope only occurs in the circalittoral zone (below 15 m) and is not subject to emergence.

Wave exposure changes - local increase	The biotope exists in areas with physically-sheltered conditions of low wave exposure and weak tidal currents. An increase in wave exposure is likely to change the composition of species present in the biotope because it is likely to disrupt feeding and burrowing and may also have an impact on reproduction and recruitment. An increase in the factor can also change the sediment characteristics which may result in a change in the proportion of suspension to deposit feeders within it. Sea pens, for example, may be unable to feed and may be damaged or broken by increased wave exposure. *Virgularia mirabilis* is able to withdraw into the sediment to avoid the factor but will be unable to feed if wave exposure increases are long term and will be likely to die. Coarser material is more difficult to burrow through, and organisms need to be robust to survive and so a major decline in the number of species able to inhabit the biotope is likely to result. Even very deep burrowing species like *Callianassa subterranea* are likely to be affected because increased wave exposure will probably disturb burrow openings and water flow through the burrows making feeding difficult. With the loss of key species, in particular the sea pens, the biotope will change so intolerance is assessed as high. See additional information for details of recovery.
Wave exposure changes - local decrease	The biotope occurs in areas of very low or no wave exposure so a decrease is not relevant.
Water clarity increase	A decrease in turbidity, increasing light availability may increase primary production by phytoplankton in the water column. However, productivity in the CMU.SpMeg biotope is secondary (detritus) and is not likely to be significantly affected by changes in turbidity and so intolerance is assessed as low. In estuaries and surf zones on the lower shore turbidity can be measured in g/l so the benchmark level is low in comparison. Nevertheless, primary production by pelagic phytoplankton and microphytobenthos do contribute to benthic communities and long term decreases in turbidity may increase the overall organic input to the detritus. Increased food supply may increase growth rates and fecundity of some species in the biotope. *Nephrops norvegicus* avoid bright light and exposure to high intensities causes blindness (Loew, 1976) and so a decrease in light attenuation resulting from decreased turbidity may affect the depth at which the species is present or more likely that *Nephrops* will only feed at night. See additional information for details of recovery.
Water clarity decrease	An increase in turbidity, reducing light availability may reduce primary production by phytoplankton in the water column. However, productivity in the CMU.SpMeg biotope is secondary (detritus) and is not likely to be significantly affected by changes in turbidity and so intolerance is assessed as low. In estuaries and surf zones on the lower shore turbidity can be measured in g/l so the benchmark level is low in comparison. Nevertheless, primary production by pelagic phytoplankton and microphytobenthos do contribute to benthic communities and so long term increases in turbidity may reduce the overall organic content of the detritus. Reduced food supply may affect growth rates and fecundity of some species in the biotope so intolerance is assessed as low. On return to normal turbidity levels recovery will be high as food availability returns to normal.

Habitat structure changes - removal of substratum (extraction)	Most species are infaunal or epifaunal and will be lost if the substratum is removed so the overall intolerance of the biotope is high. Although some of the mobile species in the biotope may be able to escape, most, such as the harbour swimming crab *Liocarcinus depurator* and the starfish *Asterias rubens* are not very fast moving and so are also likely to be removed. Nothing is known about the life cycle and population dynamics of British sea pens, but data from other species suggest that they are likely to be long-lived and slow growing with patchy and intermittent recruitment. The burrowing megafauna in the biotope vary in their longevity and reproductive strategies and some species do not reach sexual maturity for several years. *Calocaris macandreae*, for example, does not reproduce until five years old. Therefore, it seems likely that a community of sea pens and burrowing megafauna may take longer than five years to recover and so a recoverability rank of moderate is reported (see additional information).
Heavy abrasion, primarily at the seabed surface	The biotope is subject to physical disturbance because it supports a major fishery for one of its characteristic species, *Nephrops norvegicus*. Information on the effects of trawling on the other fauna in the biotope is limited but it is likely that the deep burrowing species such as the crustaceans *Callianassa subterranea* and *Jaxea nocturna* and the echiuran worm *Maxmuelleria lankesteri* and some burrowing fish will be little affected by this type of disturbance. Individual burrowing crustaceans may occasionally be displaced from burrow openings by towed gear (Atkinson, 1989). However, the animals will be able to re-establish burrow openings if these become blocked so recovery would be immediate. Of the three sea pen species *Funiculina quadrangularis* is likely to be the most sensitive to abrasion and disturbance because it has a long brittle stalk and is unable to retract into the sediment. However, experimental studies have shown that all three species of seapen can re-anchor themselves in the sediment if dislodged by fishing gear (Eno *et al.*, 1996). Eno *et al.* (1996) found that even if damaged *Funiculina quadrangularis* appeared to remain functional and this could also be true of the other sea pens. However, the apparent absence of *Funiculina* from open-coast *Nephrops* grounds may be a consequence of its susceptibility to trawl damage (D.W. Connor, pers. comm. in Hughes, 1998b). In long term experimental trawling Tuck *et al.* (1998) found no effect on *Virgularia mirabilis* populations and Kinnear *et al.* (1996) found that sea pens were quite resilient to being smothered, dragged or uprooted by creels. The investigation by Tuck *et al.* (1998) examined the effects of extensive and repeated experimental trawl disturbance on whole benthic communities over an 18 month period in a Scottish loch that had previously been un-fished for 25 years. The subsequent patterns of recovery over a further 18 month period were also investigated. Trawling disturbance resulted in reduced species diversity and a disproportionate increase in the abundance of a few dominant species, in particular the opportunistic polychaetes *Chaetozone setosa* and *Caulleriella zetlandica*. Other species, also found in this biotope, that were observed to be sensitive include the bivalves *Nucula nitidosa* and *Corbula gibba* and the polychaetes *Nephtys* sp. and *Terebellides stroemi*. For epifaunal species, no long-term effects on the total number of species or individuals were detected, but individual species did show effects, notably an increase in the density of *Ophiura* sp. and a decrease in numbers of the fish *Hippoglossoides platessoides* and the whelk *Buccinum undatum*. Other authors have also suggested that increases in echinoderm populations in the North Sea are
Light abrasion at the surface only	

	associated with fishing disturbance (Aronson, 1990; Lindley *et al.*, 1995). Scavenging species such as *Liocarcinus depurator*, *Pagurus bernhardus* and *Asterias rubens* might be expected to benefit from fishing disturbance, through increased food availability. Kaiser & Spencer (1994) found that benthic disturbance by fishing gear caused an increase in the density of epifaunal scavengers, in response to an increase in food availability in the form of damaged and disturbed organisms. The long term effects on infauna were still noticeable after 18 months and short term effects on epifauna recovered 6 months after fishing ceased. During long term monitoring of fishing disturbance on the Northumberland coast Frid *et al.* (1999) observed a decrease in numbers of sedentary polychaetes, echinoid echinoderms and large (>5 cm) brittlestars. Observations of the effects of *Nephrops* trawl fishing in the Irish Sea led Ball *et al.* (2000a) to suggest that the bivalves *Corbula gibba* and *Thyasira flexusa* were sensitive to fishing disturbance. Thus, it appears that abrasion and physical disturbance, such as that caused by fish trawling or scallop dredging, is likely to affect the species composition of the biotope and so intolerance is assessed as intermediate. Recovery is expected to be high (see additional information).
	The biotope will have low intolerance to smothering by 5 cm of sediment because most species are burrowing and live within the sediment anyway. The burrowing thalassinidean crustaceans, the echiuran worm *Maxmuelleria lankesteri*, infaunal polychaetes, brittlestars and bivalves are not likely to be affected by smothering by 5 cm of sediment. There may be an energetic cost expended to either re-establish burrow openings or to move up through the sediment though this is not likely to be significant. The sea pens *Virgularia mirabilis* and *Pennatula phosphorea* are able to withdraw rapidly into the sediment and appear to be able to recover from smothering. Although the sea pen *Funiculina quadrangularis* is not able to withdraw into the sediment its height, up to 2m, means that it is unlikely to be affected by smothering of 5cm of sediment. Most animals will be able to reburrow or move up through the sediment within hours or days so recovery is set at immediate (see additional information). Intolerance to smothering by other factors such as oil may be higher.
Siltation rate changes	Most species in the biotope are burrowing infauna so will not be affected by an increase in suspended sediment. There may be possible clogging of the feeding organs of the suspension feeding sea pens although since these animals are able to self-clean this is not likely to be very energetically costly, particularly at the level of the benchmark. Some species may benefit from increased food supply if suspended sediment has a high organic content. However, since most species in the biotope have low intolerance to an increase in suspended sediment at the benchmark level an overall rank of low is also reported for the biotope. Overall species composition and richness is not expected to be affected. On return to normal, suspended sediment levels recovery will be immediate as affected species will be able to self-clean within a few days.
	A decrease in suspended sediment and siltation will reduce the flux of particulate material to the seabed. Since this includes organic matter the supply of food to the biotope would probably also be reduced. However, the benchmark is a reduction in suspended sediment of 100 mg/l for a month which is unlikely to have a significant effect on the biotope and would not alter species composition. Intolerance is therefore, assessed as low. On return to

	normal conditions, recovery will be rapid and a rank of very high is recorded.
Introduction or spread of non-indigenous species.	The only major disease causing organism found in the biotope is the dinoflagellate parasite, *Hematodinium* sp. found in *Nephrops* populations from the west of Scotland, Irish Sea and North Sea (Hughes, 1998b). The parasite occurs in the blood and connective tissue spaces and appears to cause death by blocking the delivery of oxygen to the host's tissues (Taylor *et al*., 1996). Infection is at its highest in the spring and early summer when a dense concentration of parasite cells in the blood give *Nephrops* an abnormal bright orange body and milky white ventral abdomen. Heavily infected animals become moribund, spend more time out of their burrows than healthy individuals making them more vulnerable to predation and fishing gear. Heavy infestation is fatal. The ecological consequences of *Hematodinium* infection and host mortality in *Nephrops* populations are unknown, but there are potential economic implications, since the disease adversely affects meat quality. Since the parasite can cause mortality of a species within the biotope intolerance is assessed as intermediate. However, so far the *Nephrops* fishery has not suffered any serious decline. The infection appears to be cyclical. In the Clyde Sea infection peaked in 1991-92 at 70% and had declined to 10 - 20% by 1996-7 so recovery appears to be possible within five years and so a rank of high is reported.
Introduction of microbial pathogens	Large active animals with high respiratory demands will be most affected by oxygen depletion. In moderately hypoxic conditions (1mg l^{-1}) *Nephrops norvegicus* compensates by increasing production of haemocyanin (Baden *et al*., 1990). In the laboratory this compensation lasted one week so at the level of the benchmark the species will not be killed. However, at levels of about 0.6 mg l^{-1}> the species died within 4 days. Catches of *Nephrops norvegicus* have been observed to be high when oxygenation in the water is low, probably because animals are forced out their burrows. Thalassinidean mud-shrimps are very resistant to oxygen depletion and enriched sulphide levels. *Callianassa subterranea*, for example, often lives in hypoxic or even anoxic conditions. *Virgularia mirabilis* is often found in sea lochs so may be able to tolerate some reduction in oxygenation. However, Jones *et al*., (2000) found sea pen communities to be absent from areas which are deoxygenated and characterized by a distinctive bacterial community and Hoare & Wilson (1977) reported *Virgularia mirabilis* absent from sewage related anoxic areas of Holyhead harbour. Therefore, the benchmark level of 2 mg/l of oxygenation for one week will result in the death of only the most intolerant species and maybe some individual sea pens. The total loss of populations of the key is not likely to occur at the benchmark level and since the faunal composition of the overall biotope is unlikely to change to any great extent intolerance is assessed as low. On return to normal oxygenation recovery will be immediate as respiratory rates return to normal. However, recruitment of intolerant species that are killed will be required to return the biotope to pre-impact species diversity.

Removal of non-target habitat	*Nephrops norvegicus* is a characterizing species and *Nephrops* fisheries are of major economic importance. The species is fished throughout most of the geographic range of the biotopes in which it occurs including CMU.SpMeg. In trawled areas it is likely that the density of *Nephrops norvegicus* has been reduced but Hughes (1998b) reports that most stocks have the potential to recover even after heavy fishing pressure. Atkinson (1989) concluded that trawling for *Nephrops* was unlikely to affect other megafaunal burrowers to any great extent. The upper section of burrows will be disrupted by trawling but observations in Loch Sween have shown that surface openings are soon re-established (Hughes, 1998b). Some sea pens are likely to be uprooted by trawling activities although in observations of the impact of creeling activities all three British species proved able to re-anchor themselves provided the basal peduncle remained in contact with the sediment surface. Crabs such as *Liocarcinus depurator* are often extracted as a by-catch species in benthic trawling. A reduction in the density of predators may affect species abundance but is not likely to have a significant effect on overall species diversity. Removal of *Nephrops norvegicus* would probably not change the nature of the biotope because there are likely to be other megafaunal burrowers present. None of the key or important species in the biotope are targeted for collection or harvesting. An intolerance of intermediate has been suggested to reflect likely loss of *Nephrops norvegicus*. Recovery is likely to be high.

2.25	Shallow tideswept coarse sands SS.SCS.ICS.MoeVen
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Venerid species have a wide geographical range and occur at least as far south as west Africa (Hayward et al., 1996), and are therefore able to tolerate higher temperatures than are experienced in Britain and Ireland. Intolerance to chronic temperature increase is assessed as low. The biotope is more likely to be intolerant of an acute temperature increase which may cause physiological disruption and hence affect growth and reproduction. Physiological function should return to normal with original temperature levels and therefore recoverability will be high.
Temperature changes - local decrease	Venerid species in the biotope have a wide geographical range and occur at least as far north as Norway (Hayward et al., 1996), and are therefore able to tolerate lower temperatures than are experienced in Britain and Ireland. Intolerance to chronic temperature decrease is assessed as low. The biotope is more likely to be intolerant of an acute temperature decrease which may cause physiological disruption, affecting growth and reproduction. Physiological function should return to normal with original temperature levels and therefore recoverability will be very high. Depth is an important factor due to the increasing buffering effect with increased depth.
Water flow (tidal current) changes - local increase	Tidal currents determine, to an extent, the nature of the substratum, influence the stability of the sediment and the nature of the food supply for benthic organisms (Warwick & Uncles, 1980). This biotope occurs in areas of 'moderately strong' or 'weak' tidal streams (Connor et al., 1997a), the benchmark change in water flow rate would increase this to 'strong' or 'very strong' flow for one year. The increased water flow rate affects the sediment characteristics, primarily by re-suspension, preventing deposition of finer particles, and increased sediment mobility (Hiscock, 1983). Changes in sediment characteristics, and therefore a decrease in food supply, could result in unsuitability for burrowing deposit feeders. Strong tidal streams could compromise the feeding and respiration of suspension feeders. Mortality, particularly of deposit feeders, and a decline in species richness is possible. Recoverability is assessed as high.
Water flow (tidal current) changes - local decrease	Tidal currents determine, to an extent, the nature of the substratum, influence the stability of the sediment and the nature of the food supply for benthic organisms (Warwick & Uncles, 1980). This biotope occurs in areas of 'moderately strong' or 'weak' tidal streams (Connor et al., 1997a). The benchmark change in water flow rate would place the biotope in areas of 'very weak' flow for one year. Venerid bivalves are capable of generating their own feeding and respiration currents, feeding and respiration structures may become clogged, but are probably capable of clearing these structures (Grant & Thorpe, 1991; Navarro & Widows, 1997). Intolerance is assessed as low, with a high recoverability.

Emergence regime changes - local increase	The benchmark for emergence is an increase in exposure for one hour every tidal cycle for a year. Over the course of a year, mortality is expected in individuals highest up the shore due to the additional energetic cost and compromised feeding and respiration. Intolerance is therefore assessed as intermediate and recoverability is recorded as high. The lower limits of the biotope will remain immersed and so species richness is likely to remain unchanged.
Emergence regime changes - local decrease	A decrease in emergence at the benchmark level may benefit species in this biotope, allowing for migration further up the shore.
Wave exposure changes - local increase	The benchmark increase in wave exposure would place some of the biotope in the 'extremely exposed' category (Connor et al., 1997a). Oscillatory water movement occurs down to about 60 m when a force 8 wind is blowing at the sea surface (Hiscock, 1983) and therefore the biotope will definitely experience the effects of increased wave exposure. Hiscock (1983) reviewed the effects: fine sediments would be eroded resulting in the likely reduction of the habitat of many infaunal species and a decrease in food availability for deposit feeders; species may be damaged or dislodged by scouring from sand and gravel mobilized by increased wave action; strong wave action is likely to cause damage or withdrawal of delicate feeding and respiration structures of species within the biotope resulting in loss of feeding opportunities and compromised growth. It is likely that the benchmark increase in wave exposure would result in a shift in substratum type and associated community and with an increased abundance of more robust species, such as *Spisula elliptica*, and *Nephtys cirrosa*. The above considerations are likely to result in some mortality of many species, including the venerid bivalves and therefore biotope intolerance is assessed as intermediate with a decline in species richness. Recoverability is recorded as high (see additional information below).
Wave exposure changes - local decrease	The benchmark decrease in wave exposure would place the biotope in the 'very sheltered' or 'extremely sheltered' category (Connor et al., 1997a). The decrease in water movement would result in increased siltation and a consequent change in sediment characteristics (Hiscock, 1983). A higher proportion of fine sediment would probably result in an increase in abundance of the deposit feeders, particularly species which favour finer sediments, such as polychaetes. The increase is likely to be at the expense of suspension feeders, such as the venerid bivalves. There is likely to be some mortality of suspension feeders and hence intolerance is assessed as intermediate with a minor decline in species richness. Recoverability is assessed as high.
Water clarity increase	A decrease in turbidity in the water column above the biotope may result in increased primary production by phytoplankton due to increased light availability and therefore a potential increase in food supply to the benthic suspension and deposit feeders. The benthos is probably supported predominantly by pelagic production and by detrital materials emanating from the coastal fringe (Barnes & Hughes, 1992). It is therefore not likely that there would be any significant effect over a year and so the biotope is assessed as not sensitive.

Water clarity decrease	The benthic fauna rely on nutrient input from pelagic and coastal fringe production (Barnes & Hughes, 1992). Increased turbidity in these areas may reduce primary production derived from algae present in MoeVen and consequently reduce the food supply. Fauna may suffer decreased growth and reproduction. However, the biotope relies predominantly on nutrient input from a very wide area and the decrease in food supply is not likely to cause mortality over a year, so biotope intolerance is assessed as low. Primary production will quickly return to normal levels when turbidity decreases so recoverability is assessed as very high.
Habitat structure changes - removal of substratum (extraction)	Removal of the substratum would also remove entire populations of the infauna and sessile epifauna in the biotope. Intolerance is therefore assessed as high and there would be a major decline in species richness. Recoverability is assessed as high.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	Despite their robust body form, bivalves are vulnerable to physical abrasion. Bergman & van Santbrink (2000) suggested that bivalves such as *Dosinia lupinus* and *Spisula solida* were amongst the species most vulnerable to direct mortality due to bottom trawling in sandy sediments. Bivalves such as *Ensis* sp., *Corbula gibba* and *Chamelea gallina* are relatively resistant (Bergman & van Santbrink, 2000). Venerid bivalves are generally shallow burrowers and may therefore be damaged by physical abrasion. Polychaetes with their soft bodies and inhabiting the top few centimetres of sediment expose palps at the surface whilst feeding. They are therefore also likely to be damaged by the benchmark physical abrasion. It seems likely that the characterizing species will suffer some mortality due to physical abrasion and so intolerance is assessed as intermediate. Recoverability is recorded as high (see additional information below). Particularly vulnerable forms, such as the epifaunal echinoderms, may be eliminated so there may be a minor decline in species richness in the biotope.
Siltation rate changes	Venerid bivalves are shallow burrowing infauna. They are active suspension feeders and therefore require their siphons to be above the sediment surface in order to maintain a feeding and respiration current. Shallow burying, siphonate suspension feeders and other infaunal species are typically able to escape smothering with the benchmark level of 5 cm of their native sediment and relocate to their preferred depth by burrowing (Kranz, 1972 in Maurer, 1986). Smothering will result in temporary cessation of feeding and respiration. The energetic cost may impair growth and reproduction but is unlikely to cause mortality. Biotope intolerance is therefore assessed as low. The effect on growth and reproduction will probably not extend beyond 6 months and therefore recoverability is assessed as very high.

	Venerid bivalves are active suspension feeders, trapping food particles on their gill filaments (ctenidia). An increase in suspended sediment has the potential to affect feeding and respiration by clogging the ctenidia. However, other suspension feeding bivalves are able to clear their feeding and respiration structures, at little energetic cost (Grant & Thorpe, 1991; Navarro & Widdows, 1997); it seems likely that venerids would also be capable of this. At the benchmark level, no mortality of suspension feeders is expected in this time. Therefore, intolerance is assessed as low. When suspended sediment returns to original levels, metabolic activity should quickly return to normal and recoverability is assessed as very high. An increase in suspended sediment is likely to lead to an increase in siltation and therefore a greater proportion of fine sediments in the substratum. This would tend to favour the deposit feeders in the biotope and there may be a shift in community composition away from suspension feeders. However, over the benchmark period of one month there is not likely to be any decline in species richness.
	The majority of species in the biotope are suspension feeders, with some deposit feeders which rely on a supply of nutrients in the water column and at the sediment surface. A decrease in the suspended sediment would result in decreased food availability for suspension feeders. It would also result in a decreased rate of deposition on the substratum surface and therefore a reduction in food availability for deposit feeders. This could impair growth and reproduction. At the benchmark exposure period of a month, it is unlikely to cause mortality or a decline in species richness and so an intolerance of low is recorded. On return to normal suspended sediment levels, feeding activity would return to normal and hence recovery is recorded as very high.
Introduction or spread of non-indigenous species.	It is unlikely that any of the species within this biotope would be targeted for extraction. The biotope is potentially at risk from fishing activities on sandy substrata, e.g. dredging for scallops (Eleftheriou & Robertson, 1992), beam trawling for flatfish, and extraction of sand by the aggregate industry (Eno,1991). Venerid bivalves are generally shallow burrowers (Fish & Fish, 1996). The bivalves that characterize the biotope may therefore be damaged by bottom fishing. Bergman & van Santbrink (2000) suggested that the megafauna such as *Dosinia lupinus*, *Spisula solida* are amongst the species most vulnerable to direct mortality due to bottom trawling in sandy sediments. More robust bodied or thick shells species, such as the bivalves *Ensis* sp., *Corbula gibba*, and *Chamelea gallina*, are likely to be less sensitive and therefore more resistant. Biotope intolerance is therefore recorded as intermediate. Recoverability is assessed as high. It is unlikely that there would be a major change in species richness, as extraction will not eradicate a species entirely.
Introduction of microbial pathogens	Despite the tolerance of the larger bivalves in the biotope to deoxygenation, growth and reproduction are still likely to be compromised and so intolerance is assessed as intermediate. Growth and reproduction should rapidly return to normal when normoxic conditions are restored so recoverability is recorded as very high. Some species are intolerant to hypoxia, and therefore will decline in abundance, including polychaetes *Owenia fusiformis*, *Lanice conchilega*, *Spio filicornis* and echinoderms.

Removal of non-target habitat	It is unlikely that any of the species within this biotope would be targeted for extraction. The biotope is potentially at risk from fishing activities on sandy substrata, e.g. dredging for scallops (Eleftheriou & Robertson, 1992), beam trawling for flatfish, and extraction of sand by the aggregate industry (Eno,1991). Venerid bivalves are generally shallow burrowers (Fish & Fish, 1996). The bivalves that characterize the biotope may therefore be damaged by bottom fishing. Bergman & van Santbrink (2000) suggested that the megafauna such as *Dosinia lupinus*, *Spisula solida* are amongst the species most vulnerable to direct mortality due to bottom trawling in sandy sediments. More robust bodied or thick shells species, such as the bivalves *Ensis* sp., *Corbula gibba*, and *Chamelea gallina*, are likely to be less sensitive and therefore more resistant. Biotope intolerance is therefore recorded as intermediate. Recoverability is assessed as high. It is unlikely that there would be a major change in species richness, as extraction will not eradicate a species entirely.

2.26	**Sheltered muddy gravel Ls.LMx.Mx.CirCer**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	This biotope occurs intertidally and is therefore likely to be relatively tolerant of changes in temperature as experienced during cyclical periods of immersion and emersion. The cirratulid *Aphelochaeta marioni* (studied as *Tharyx marioni*) has been recorded from the Baltic to the Indian Ocean and so it probably has some degree of adaptation or tolerance to a range of temperatures (Hartmann-Schroder, 1974 and Rogall, 1977, cited in Farke, 1979). However, acute rises in temperature may have a more deleterious effect. George (1964a) reported that a rapid rise or fall in temperature of 3°C was sufficient to induce spawning in 25% of mature *Cirriformia tentaculata*. If this occurred at a time of year that was not suitable for larval survival then larval mortality could be high. The upper lethal limits for *Cirriformia tentaculata* from the Hamble were reported to be of 32°C and 29°C for 5-6 day old and adult *Cirriformia tentaculata* respectively (George, 1964b). The upper temperature tolerance (that killed half of the test organisms after 96 hours) of the oligochaete *Tubificoides benedii* (studied as *Peloscolex benedeni*) was reported to be 28.5°C (Diaz, 1980). However, temperatures of this magnitude are unlikely to be experienced by this intertidal biotope. *Cirriformia tentaculata* is reported to be near its northern limit in the British Isles (George, 1968) and an increase in temperature may lead to the extension of its upper distribution range. An increase in temperature could also serve to decrease the length of time spent in the larval phase and so reduce the risk of predation. The rate of larval growth in *Cirriformia tentaculata* was found to be twice as fast at 20°C than at 8°C.Much work has been done on the temperature tolerances in *Cerastoderma edule* (see MarLIN review). Kristensen (1958) reported that *Cerastoderma edule* from the Dutch Wadden Sea had an upper temperature tolerance of 31°C for 24 hrs, but that spat (3-6 mm) were more tolerant. Ansell et al. (1981) reported an upper median lethal temperature of 35°C after 24 hrs (29°C after 96 hrs exposure). Wilson (1981) noted that *Cerastoderma edule* had limited ability to acclimate. However, Newell & Bayne (1980) stated that *Cerastoderma edule* was able to acclimate to a temperature change of 10°C and regulate its metabolic rate in response to rising spring temperatures. Temperature tolerance in the above studies was dependant on the environmental temperature, i.e. specimens collected in summer or areas of higher average temperature tolerated higher temperatures than specimens collected in winter and/or at lower average temperatures. Therefore, the intolerance of *Cerastoderma edule* to temperature change will be dependant on season. Rapid increases in temperature during the spawning season may initiate spawning (Ducrotoy et al., 1991). Wilson (1993) concluded that *Cerastoderma edule* was probably tolerant of a long-term temperature rise of 2°C associated with climate change. On balance, it is unlikely that an increase in temperature similar to that of the benchmark will cause significant mortality within the biotope. An intolerance of low has been recorded, reflecting some physiological stress in less tolerant species but with a low confidence. Recoverability has been assessed as high (see additional information).
Temperature changes -	This biotope occurs intertidally and is therefore likely to be relatively tolerant of changes in temperature as experienced during cyclical periods of immersion and

local decrease	emersion. *Aphelochaeta marioni* (studied as *Tharyx marioni*) has been recorded from the Baltic to the Indian Ocean and so it probably has some degree of adaptation or tolerance to a range of temperatures (Hartmann-Schroder, 1974 and Rogall, 1977, cited in Farke, 1979). Short periods of severe frost in November 1973 were not reported to have affected the population of *Aphelochaeta marioni* (studied as *Tharyx marioni*) in the German Bight (Farke, 1979). Acute falls in temperature may have a more deleterious effect. George (1964a) reported that a rapid rise or fall in temperature of 3°C was sufficient to induce spawning in 25 % of mature *Cirriformia tentaculata*. If this occurred at a time of year that was not suitable for larval survival then larval mortality could be high. However, George (1964b) noted that although in Southampton the incoming tide incurred a drop of 6°C in five minutes, such rapid changes in temperature had no significant effect on the mortality of either juvenile of adult *Cirriformia tentaculata* in the laboratory. The larvae of this species grow twice as slow at 8°C than they do at 20°C (George, 1964). Any increase in the length of time spent in the larval phase will increase the risk of predation. In adults, field data suggests that growth ceases at 6°C (George, 1964). On the Hamble, lower lethal limits of -6°C (by extrapolation) and 2°C have been reported for 5-6 day old and adult *Cirriformia tentaculata* respectively (George, 1964b). These are temperatures that can reasonably be expected in winter in this intertidal biotope and so some mortality is likely. Furthermore, *Cirriformia tentaculata* is reported to be near its northern limit in the British Isles (George, 1968) and a long term chronic decrease in temperature could serve to exclude this species from the northern extent of its distribution. George (1968) reported several major changes and a major reduction in the distribution range of *Cirriformia tentaculata* following the severe winter of 1962/3. In temperature tolerance experiments, no *Cirriformia tentaculata* survived even a brief exposure to -2°C or 96 hours at 0°C. The cirratulid *Cirratulus cirratus* was found to be tolerant to lower temperatures and it is possible that this species will become more prevalent in this biotope if the temperature falls. George (1968) reported that the ciliary feeding mechanisms of *Cirriformia tentaculata* became so inefficient at low temperatures that, over long periods, the animal may die of starvation. George (1968) also mentioned that the animal does not withdraw its branchiae in cold weather. Due to their delicate nature, the branchiae may subsequently freeze on the surface. In such a case, the animal would be living under anaerobic conditions and so emerges from the burrow to enable them to respire through their body surface. This emergence would increase both risk of predation and of freezing. High mortalities of cockle populations due to severe winters have been reported by many authors. Kristensen (1958) reported that the sediment froze to a depth of 10 cm and 15 cm, resulting in death of cockles in areas of the Wadden Sea in the severe winter of 1954. Hancock & Urquhart (1964) report almost 100% mortality of cockles in Llanrhidian Sands, Burry Inlet and high mortalities of cockles in other areas around the UK after the winter of 1962/63. Beukema (1990) considered *Cerastoderma edule* to be intolerant of cold winters. Kristensen (1958) reported that *Cerastoderma edule* from the Dutch Wadden Sea died within 24 hrs at -1.9°C. Smaal et al. (1997) stated that *Cerastoderma edule* is unable to acclimate to low temperatures. No specific information concerning the effects of a decrease in temperature on the other important characterizing species was found but an intolerance of high has been recorded to reflect mortality in the studies mentioned above. Providing some part of the affected species' population survived, recoverability is expected to be moderate.

Salinity changes - local increase	Studies on *Cirriformia tentaculata* from Hamble Spit in Southampton recorded that the upper and lower lethal salinities were 52 and 14‰ respectively (George, 1964b). In the same study, salinity changes in the top centimetre of mud were found to vary drastically when compared to sediment at a depth of 6-8 cm. For example, the salinity of interstitial water after five and a half hours of hot and sunny weather was 45‰ in the top centimetre but almost the same as the surrounding seawater (35‰) at 6-8 cm. Similarly, the salinity of interstitial seawater was about 24‰ after five hours of heavy rain whereas it was only 33‰ at 6-8 cm. Considering many of the polychaetes in this biotope are buried below the top centimetre of sediment or live within tubes above the surface it is likely that they will, to some degree, be buffered against large fluctuations. The fact that this biotope is intertidal also means that the associated fauna have some inherent tolerance to fluctuating salinities to a certain degree. The salinity tolerance of *Tubificoides benedii* (as *Peloscolex benedeni*) ranged from 2.8 to >34 ‰ at 5°C and salinity was considered to the primary factor influencing its distribution (Diaz, 1980).Some species within this biotope can tolerate a wide range of salinities including *Cerastoderma edule* (see MarLIN review) and *Corophium volutator*. *Corophium volutator* has been reported to be able to survive a salinity of 50 ‰ although normal functioning is impaired above 30‰ (McLusky, 1967, 1968). Due to the fact that this biotope occurs in variable salinities (ranging from 18-40 psu), an increase in salinity similar to that in the benchmark is unlikely to adversely affect the viability of the associated fauna and tolerant has been recorded.
Water flow (tidal current) changes - local increase	The biotope is associated with weak and very weak tidal streams and is therefore likely to be adversely affected by an increase in water flow rate at the benchmark level. The increased flow rate will change the sediment characteristics in which the species lives and essentially, the habitat could be lost. Finer sediment particles such as silt and mud are likely to be lost. Less than half of the sediment in this biotope is mud but it is the preferred habitat for some important characterizing species. The cirratulid *Aphelochaeta marioni*, for example, prefers a habitat with a high silt content (Gibbs, 1969). Therefore, the species would be outside its habitat preference and mortality would be likely. Additionally, the consequent lack of deposition of particulate matter at the sediment surface would greatly reduce food availability for all deposit feeders. Over the course of a year this is likely to adversely affect growth rates and fecundity. George (1964b) found that particle size was negatively correlated with the density of *Cirriformia tentaculata* in Hamble Spit, Southampton. However, he suggested that this was probably as much to do with availability of organic matter, it being generally lower in the areas with higher grain sizes. There was a positive correlation between the amount of organic matter and the number of worms. Nephtys are one of the few polychaetes that are able to live in shifting sand and can penetrate and move through sand very efficiently (Truman & Ansell, 1969). *Nephtys hombergii* is a predatory polychaete and if this species can tolerate an increased water flow rate whilst other polychaetes are suffering then mortality is expected to further increase. An increased water flow rate may also interfere with the delicate feeding apparatus of suspension feeders such as *Cerastoderma edule* leading to a reduced food consumption. Increasing water flow may remove adult *Cerastoderma edule* from the sediment surface and carry them to unfavourable substratum or deep water, where they may be lost from the population. Coffen-Smout & Rees (1999) reported that cockles could be distributed by flood and ebb tides, but especially flood tides (by rolling around

	the surface) up to 0.45 m on neap tides or between 94 m and 164 m on spring tides. Newly settled spat and juveniles (<4.8mm) are capable of bysso-pelagic dispersal. Therefore, water flow rates probably affect the distribution and dispersal of juveniles and adults. An increase in water flow rate at the benchmark level is likely to have a similar effect to substratum loss and accordingly, an intolerance of high has been suggested. Recoverability is expected to be moderate (see additional information).
Water flow (tidal current) changes - local decrease	The biotope is associated with weak and very weak tidal streams and is therefore unlikely to be adversely affected by a decrease in water flow rate. Decreasing water flow rate may increase siltation and change the proportions of sand and gravel in the sediment to favour muddy substrates. Such substrata are unsuitable for *Cerastoderma edule* and Boyden & Russell (1972) suggested that lack of tidal flow may exclude *Cerastoderma edule* possibly due to reduced food availability as suggested by Brock (1979). An intolerance of intermediate has been recorded to reflect cockle mortality. Recoverability is likely to be high.
Emergence regime changes - local increase	An increase in emergence, equivalent to one hour not covered by the sea, will render the biotope more susceptible to desiccation, extremes of temperature and predation pressure from shore birds. If the branchiae of the cirratulid *Cirriformia tentaculata* are exposed they will either be withdrawn into the burrow of the worm or clump together and stop functioning properly (Dales & Warren, 1980). *Aphelochaeta marioni*, another cirratulid, can only feed when immersed and therefore will experience reduced feeding opportunities. Over the course of a year the resultant energetic cost is likely to cause some mortality and the upper limit of the biotope will be reduced. An intolerance of intermediate has been recorded to reflect this mortality. Recoverability has been assessed as high because some proportion of each population are likely to remain (see additional information).
Emergence regime changes - local decrease	A decrease in emergence will reduce the tidally induced stresses of desiccation, hypersalinity, extremes of temperature and predation by shore birds. Predation by fish may increase but so may the extent of the lower limit of the population provided a suitable substratum remained. Therefore, tolerant has been recorded.
Wave exposure changes - local increase	This biotope occurs in very sheltered and extremely sheltered habitats and is therefore likely to be highly sensitive to an increase in wave exposure similar to that of the benchmark. Species on the sediment surface including cockles and tube building polychaetes are likely to be washed away and may end up in unfavourable habitats. Infauna may also be dislodged if the top layers centimetres of sediment are removed. This will render the worms more susceptible to predation. Rough seas in March 1960 were found to wash away young *Cirriformia tentaculata* from the top surface layers of mud at Hamble Spit, Southampton (George, 1964b). Polychaetes living further down in the sediment may be saved from dislodgement but the biotope per se will be lost. Therefore, intolerance has been assessed as high. This factor is likely to have a similar effect to substratum loss and accordingly, recoverability has been assessed as moderate.
Wave exposure changes - local decrease	This biotope occurs in very sheltered and extremely sheltered habitats and therefore is therefore likely to be tolerant of a decrease in wave exposure.

Water clarity increase	A decrease in turbidity may stimulate further primary production in the water column. This would increase food availability for the suspension feeders and also the amount of organic material reaching the sediment surface. Therefore tolerant* has been recorded.
Water clarity decrease	An increase in turbidity will mean that primary production in the water column may suffer from increased light attenuation. The photosynthetic capabilities of epifaunal algae within the biotope may also decrease. Plankton drifting in from other areas will dampen the effect of a reduction in food availability for the suspension and deposit feeders but over the course of a year the species are likely to experience some reduced feeding and fecundity. Therefore a low intolerance has been recorded with a high recoverability.
Habitat structure changes - removal of substratum (extraction)	All the characterizing species within this species live on the surface of or within the top few centimetres of substratum. Loss of the substratum will result in loss of these species and loss of the biotope and therefore, an intolerance of high has been recorded. Recoverability is likely to be moderate (see additional information).
Heavy abrasion, primarily at the seabed surface	The majority of species within this biotope are soft bodied organisms which feed on the surface of the substratum or at least expose part of their body to the surface whilst feeding. Physical disturbance, such as cockle dredging or dragging an anchor, would be likely to penetrate the upper few centimetres of the sediment and cause physical damage to many of the important characterizing species. Birds and fish would be attracted to the site of disturbance and the fauna would be at greater risk of predation. Coffen-Smout (1998) studied simulated fisheries impacts on *Cerastoderma edule* and reported that the cockle shell withstood between 12.9 and 171.4 newtons (N) of force depending on shell size and position of load (a 1 kg weight exerts about 10 N). Cockles are often damaged during mechanical harvesting and Picket (1973) found that 20% were too damaged to be processed after hydraulic dredging. Physical disturbance equivalent to a passing scallop dredge is likely to cause a similar degree of damage. However, only a proportion of the population is likely to be affected (see extraction of key or important characterizing species) and, on balance, an intolerance of intermediate has been recorded with a high recoverability.
Light abrasion at the surface only	
Siltation rate changes	The cirratulids *Aphelochaeta marioni*, *Chaetozone gibber* and *Cirriformia tentaculata* all live buried in the top few centimetres of sediment and are therefore unlikely to be adversely affected by smothering. Maurer et al. (1986) studied the effects of dredged material on the vertical migration and mortality of four species of benthic invertebrates (including two polychaetes) and reported that the intolerance of species to smothering was influenced by the nature of the sediment. They predicted that some individuals of both the polychaete species studied (*Nereis succinea* and *Scoloplos fragilis*) would be capable of vertical migration through 0.9 m of sediment if that sediment was indigenous to their usual habitat. In a study in the Santa Catalina Basin (1240 m depth) off the California coast, Kukert & Smith (1992) reported that subsurface deposit feeders appeared to be the least susceptible to smothering when buried under 5-6 cm of sediment. All four trophic groups studied (surface-deposit feeders, sub-surface deposit feeders, omnivores and others) and both domicile groups (tube-dwellers and non-tube dwellers) were significantly reduced in absolute abundance four days after disturbance when compared to the background community. However, the macrobenthos had reached background levels within 11 months although

	community succession continued for 23 months. Burrowing was found to be a significant dispersal mode. The cirratulids would need to be able to reposition themselves in order to resume feeding at the surface and therefore smothering by heavy impermeable substances such as tar would result in an increased intolerance. *Cerastoderma edule* has short siphons and needs to keep in contact with the surface of the sediment. Jackson & James (1979) reported that few *Cerastoderma edule* buried to 10 cm in sediment were able to burrow to the surface whereas most buried to a depth of 5 cm could reach the surface. In another experiment *Cerastoderma edule* buried 10 cm in sandy substrate was able to burrow near to the surface, but still suffered 83% mortality in 6 days, whereas in muddy substrates all cockles died between 3 and 6 days. Therefore, cockles are probably of intermediate intolerance to smothering by 5 cm of sediment although smaller individuals may be more intolerant. *Melinna palmata* lives in a mucous-lined tube covered in sediment that projects obliquely above the sediment (Fauchald & Jumars, 1979). In general, mucus tube feeders and labial palp deposit feeders were most intolerant to burial (Maurer et al., 1986). Smothering may result in this tube being broken which may result in the displacement or mortality of some individuals. It is not known whether other important characterizing fauna including the oligochaetes *Tubificoides benedii*, *Tubificoides pseudogaster* and the polychaete *Pygospio elegans* would be adversely affected by smothering but their mobility may enable them to dig back up through the sediment to the surface. On balance, an intolerance of intermediate with a high recoverability has been recorded following the evidence on the cockles (see additional information).
	An increase in the amount of suspended sediment could potentially increase the amount of food available to deposit feeders, the major trophic group within this biotope. However, this would only be true if the proportion of organic material within the suspended sediment increased. With regard to suspension feeders, increasing total particulate concentrations have been shown to decrease clearance rates and increase pseudofaeces production in *Cerastoderma edule* (Navarro et al., 1992; Navarro & Widdows, 1997). Furthermore, due to the sheltered nature of the habitat, siltation is likely. The increase in suspended sediment is likely to increase the proportion of mud, to the detriment of *Cerastoderma edule*. Therefore, an intolerance of intermediate has been recorded. Recovery is expected to be high (see additional information).
	A decrease in suspended sediment is likely to reduce the amount of available food for both suspension feeders and deposit feeders although at the benchmark level this is unlikely to cause mortality. Navarro & Widdows (1997) suggested that *Cerastoderma edule* was able to compensate for decrease in particulate quality (i.e. proportion of organic to inorganic seston) between 1.6 to 300 mg/l. Over the benchmark period the associated fauna may experience a temporary deleterious effect on growth and fecundity and accordingly an intolerance of low has been recorded. On resumption of normal levels of suspended sediment, recoverability is expected to be high.
Underwater noise changes	*Cerastoderma edule* can probably detect the vibration caused by predators and will withdraw its siphons. However, little information was found concerning the effect of noise or vibration on cockle populations. The polychaetes and other worms are unlikely to have the ability to detect noise and other associated fauna are also unlikely to be adversely affected. Shore birds are highly sensitive to noise and may be scared away. This would decrease the predation pressure on

	the fauna in this biotope from this source and, therefore, tolerant has been recorded.
Visual disturbance	*Aphelochaeta marioni* is only active at night and Farke (1979) noted their intolerance to visual disturbance in a microsystem in the laboratory. In order to observe feeding and breeding in the microsystem, the animals had to be gradually acclimated to lamp light. Even then, additional disturbance, such as an electronic flash, caused the retraction of palps and cirri and cessation of all activity for some minutes. Visual disturbance, in the form of direct illumination during the species' active period at night, may therefore result in loss of feeding opportunities, which may compromise growth and reproduction. *Cerastoderma edule* has well developed eyes on the sensory tentacles of the inhalant and exhalent tentacles (Charles, 1966). These probably enable the cockle to response to shadowing by predators and withdraw the siphons. However its visual acuity is probably limited and it is unlikely to be sensitive to visual presence. No information was found on the sensitivity to visual presence of other important characterizing species. However, shore birds are highly sensitive to visual presence and may be scared away. This would decrease the predation pressure on the fauna in this biotope from birds. However, in respect of the evidence for *Aphelochaeta marioni*, an intolerance of low has been recorded.
Introduction or spread of non-indigenous species.	Nearly all *Aphelochaeta marioni* (as *Tharyx marioni* individuals from Stonehouse Pool in Plymouth were infected with a sporozoan parasite of the Gonospora genus but no evidence was found that the animal was adversely affected by its presence (Gibbs, 1971). Several parasitic species have been associated with the common cockle *Cerastoderma edule* and some are known to cause mortality (see MarLIN) review. Boyden (1972) reported castration of 13% of the cockle population in the River Couch estuary due to infestation with larval digenetic trematodes. Therefore, an intolerance of intermediate has been assessed.
Introduction of microbial pathogens	Connor et al. (1997b) described sediments in which the cirratulid *Aphelochaeta marioni* is commonly found as usually having a "black anoxic layer close to the sediment surface". Broom et al. (1991) considered *Aphelochaeta marioni* (studied as *Tharyx marioni*) to be characteristic of faunal assemblage of very poorly oxygenated mud in the Severn Estuary. They found that it dominated sediments where the redox potential at 4 cm sediment depth was 56 mV and, therefore, concluded that the species was tolerant of very low oxygen tensions. Thierman et al. (1996) studied the distribution of *Aphelochaeta marioni* in relation to hydrogen sulphide concentrations. The species was found to be abundant at low sulphide concentrations (less than 50 µM) but only occasional at concentrations from 75-125 µM. They concluded that *Aphelochaeta marioni* does not display a massively adverse reaction to sulphidic conditions and is able to tolerate a low amount of sulphide. The evidence suggests that *Aphelochaeta marioni* is capable of tolerating hypoxia but it is difficult to determine to what degree. The cirratulid *Cirriformia tentaculata* is reported to have several metabolic adaptations to the hypoxic conditions to which it is periodically subjected (Dales & Warren, 1980; Bestwick et al., 1989). The sediment around their burrows is often hydrogen-sulphide rich and therefore a sink for oxygen (Bestwick et al., 1989). The adaptations are, firstly, the filamentous branchiae of the worm, that are spread out over the surface of the substratum, are very thin and oxygen uptake can continue during tidal emersion providing the branchiae are covered by a film of water (Bestwick et al., 1989). If the branchiae are exposed they may be withdrawn into the burrow at which point the gaseous

	exchange occurring across the branchial epithelium starts to fall. Secondly, the haemoglobin has an extremely high affinity for oxygen and as the internal oxygen pressure falls, oxygen is released from the haemoglobin store (Dales & Warren, 1980). At an external oxygen pressure of 0.88 mg/l, oxygen uptake stops and the species cannot tolerate anoxia for more than three days (Dales & Warren, 1980).The oligochaete *Tubificoides benedii* also inhabits sulfide rich environments and has a high capacity to tolerate anoxic conditions (Nubilier et al., 1997; Giere et al., 1999). *Tubificoides benedii* is often buried up to 10 cm deep and so has no contact with the surface but has a highly specialized adaptive physiology that allows it to maintain some oxygen consumption even at 2% (approximately 0.18 mg/l) oxygen saturation of the surrounding environment on the Isle of Sylt. The critical oxygen saturation for *Capitella capitata* is about 7.5 mg/l (Gamenick, 1996, cited in Giere et al., 1999). It has been suggested that tolerance to anoxia may be influenced by temperature. *Tubificoides benedii* (studied as *Peloscolex benedeni*) was found to be less tolerant to anoxia as temperature increased (Diaz, 1980). At 20°C, it took almost 60 hours for half the worms to be killed but at 30°C it took less than 18 hours. Boyden (1972) reported that when emersed, air breathing *Cerastoderma edule* had a median lethal survival time of 129 hrs, whereas specimens unable to 'breathe' air (i.e. those that had been clamped) or those in an oxygen free environment, had median lethal times of 69 and 75 hrs respectively, indicating that *Cerastoderma edule* was capable of anaerobic respiration. Rosenberg et al. (1991) reported 100% mortality of *Cerastoderma edule* exposed to 0.7 - 1.4 mg/l oxygen for 43 days and 98% mortality after 32 days. *Cerastoderma edule* migrated to the surface of the sediment in response to decreased oxygen concentrations. Theede et al. (1969) reported 50% mortality after 4.25 days at 2.1 mg/l oxygen. Theede et al. (1969) also noted that *Cerastoderma edule* only survived 4 days exposure to 0.0-6.1 cm^3 per litre of hydrogen sulphide, which is associated with anoxic conditions. This suggests that *Cerastoderma edule* could survive several days anoxia but it is likely that continued exposure to 2 mg/l oxygen for a week would be lethal. Therefore, despite the tolerance of many of the polychaete species in this biotope to hypoxia, an intolerance of intermediate has been recorded to reflect likely mortality in the cockles. Recoverability is expected to be high (see additional information).
Removal of target habitat	No information regarding alien species likely to compete or displace any of the species in this biotope was found.
Removal of non-target habitat	The cockle *Cerastoderma edule* is probably the most widely exploited of all intertidal species harvested by mechanical means (Hall & Harding, 1997). In just one year between 1987 and 1988, landings of *Cerastoderma edule* in the Solway Firth had increased from 234 to 3548 tonnes (Hall & Harding, 1997). Hall & Harding (1997) investigated the effects of mechanical harvesting of cockles on non-target species. Overall, the faunal structure in disturbed plots recovered within 56 days following suction dredging although a 30% decline in the number of species and a 50% decline in the number of individuals of some species was observed. In Burry Inlet, Wales, tractor towed cockle harvesting led to a reduction in density of *Pygospio elegans* (Ferns et al., 2000). In this study, numbers of *Pygospio elegans* and *Hydrobia ulvae* remained significantly reduced for more than 100 days after harvesting and *Nephtys hombergii* for more than 50 days. The effects of the harvesting were found to vary between muddy sand and clean sand with clean sand recovering more quickly in general ,

	due to the higher abundance of mobile species there. *Nephtys hombergii* for example, had recovered back to its previous abundance 56 days after harvesting in the clean sand whereas in the muddy sand the abundance was still only about a third after the same time period. Similar effects were seen in *Pygospio elegans*, *Hydrobia ulvae* and *Cerastoderma edule* but none of these three species had fully recovered more than six months after the dredging. *Capitella capitata* had almost trebled its abundance within the 56 days in the clean sandy area. Experimental bait digging resulted in a significant mortality of *Cerastoderma edule* in dug areas compared to undug areas (48% mortality in 9 days to a maximum of 85% after 11 days) probably due to smothering (Jackson & James, 1979). Smaller individuals were more likely to die than larger ones. Fowler (1999) reported 90% mortality of cockles in areas affected by bait digging, recolonization occurring three months after bait digging, although the cockle population was still different from undisturbed areas. Jackson & James (1979) pointed out that bait digging disturbs sediment to a depth of 30-40 cm and probably buries many cockles below 10 cm and surface exposure of others that are then taken by predators. They suggested that bait digging was involved in the decline in the cockle fishery on the north Norfolk Coast in the 1950s and 60s. Therefore, cockles (and the biotope in general) are probably of intermediate intolerance to bait digging although smaller individuals may be more intolerant. In years of good recruitment recovery may occur within a year, however, recruitment is sporadic (see reproduction) and may take longer in 'bad' years. See additional information for details on the recovery of the biotope.

2.26	**Sheltered muddy gravel IMX.CreAph**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Both the characterizing species in the biotope occur over a very wide geographic range. On the east coast of the Americas, *Crepidula fornicata* is found as far south as Mexico and therefore it must be able to tolerate higher temperatures than it experiences in northern Europe. The effect of temperature on larval development was investigated by Lucas & Costlow (1979). Larvae were found to tolerate daily temperature cycles of 5°C between 15°C and 30°C with little mortality. Over a 12 day period there was 0% mortality at 30°C but 100% mortality occurred by day 6 at 35°C. Thus, it seems that adult *Crepidula fornicata* are able to tolerate chronic change over time and larvae are able to tolerate acute change in the short term. *Aphelochaeta marioni* has been recorded from the Mediterranean Sea and Indian Ocean (Hartmann-Schröder, 1974; Rogall, 1977; both cited in Farke, 1979) and therefore must also be capable of tolerating higher temperatures than experienced in Northern Europe. Furthermore, *Aphelochaeta marioni* lives infaunally and so is likely to be insulated from rapid temperature change. For both the characterizing species, an increase in temperature would be expected to cause some physiological stress but no mortality and therefore an intolerance of low is recorded for the biotope. Metabolic activity should quickly return to normal when temperatures decrease and so a recoverability of very high is recorded. The majority of species in the

	biotope either live infaunally or are capable of burrowing and therefore would be insulated from rapid temperature change. Of the epifaunal species, *Mytilus edulis* is generally regarded as being eurythermal and the ascidians have a wide geographic range so are expected to tolerate variations in temperature. Hence, no decline in species richness is expected.
Temperature changes - local decrease	During the severe winter of 1962-63 the British populations of marine invertebrates were subjected to an acute decrease in temperatures. Waugh (1964) recorded 25% mortality of *Crepidula fornicata* from the south coast and east coast of England where the recorded temperatures were 5-6°C and 3-4°C respectively below normal for a period of 2 months. *Aphelochaeta marioni* is more tolerant of decreases in temperature, probably because it lives infaunally. For example, in the Wadden Sea, the population was apparently unaffected by a short period of severe frost in l973 (Farke, 1979). The intolerance of *Crepidula fornicata* is in line with the benchmarks for temperature decrease and hence the intolerance of the biotope is recorded as intermediate. Recoverability is recorded as high (see additional information below). During the cold winter of 1962-63, severe mortalities of *Carcinus maenas* were recorded, while the infaunal species (e.g. *Corophium volutator*, *Harmothoe impar*, *Nephtys hombergi*) were largely unaffected (Crisp, 1964). Species richness in the biotope is therefore expected to show a minor decline.
Salinity changes - local increase	IMX.CreAph occurs in estuaries and so the community is likely to be tolerant of variable salinities. Both characterizing species and the majority of other species in the biotope also occur on the open coast where sea water is at full salinity. Therefore the biotope is not likely to be intolerant of increases in salinity. No evidence was found concerning the reaction of the characterizing species to hypersaline conditions.
Water flow (tidal current) changes - local increase	IMX.CreAph occurs in wave protected areas where water flow is typically "moderately strong" or weaker (see glossary). An increase in water flow rate of two categories for one year would place the biotope in areas of strong or very strong flow. Increased water flow rate will change the sediment characteristics in which the biotope occurs, primarily by re-suspending and preventing deposition of finer particles (Hiscock, 1983). The underlying sediment in the biotope has a high silt content; a substratum which would not occur in very strong tidal streams. Therefore, the infaunal species, such as *Aphelochaeta marioni*, would be outside their habitat preferences and some mortality would be likely to occur. Additionally, the consequent lack of deposition of particulate matter at the sediment surface would reduce food availability for deposit feeders. The resultant energetic cost over one year would also be likely to result in some mortality. An intolerance of intermediate is therefore recorded and species richness is expected to decline. Recoverability is recorded as high (see additional information below).
Water flow (tidal current) changes - local decrease	IMX.CreAph occurs in areas of low water flow including the lowest category on the water flow scale ('very weak' - see glossary) (Connor et al., 1997a). Therefore, the biotope would be unlikely to be intolerant of decreases in water flow regime. However, it should be noted that decreased water flow rate could result in an increased settlement of suspended sediment (Hiscock, 1983) and deoxygenation. These factors are covered in their relevant sections.

Emergence regime changes - local increase	IMX.CreAph predominantly occurs subtidally. However, the upper part of the biotope is exposed at low water spring tides and therefore an increase in emergence regime is relevant. The benchmark is an additional one hour of emergence every tidal cycle. During this time, exposed individuals of all species will not be able to feed and respiration of most will be compromised. Over the period of a year, the resultant energetic cost may cause the mortality of individuals exposed for the longest time. The overall intolerance of the biotope is therefore recorded as intermediate. Particularly intolerant species, such as ascidians, would be expected to suffer total mortality and therefore there would be a minor decline in species richness. Recoverability is recorded as high (see additional information below).
Emergence regime changes - local decrease	IMX.CreAph occurs in the subtidal zone and therefore would not be intolerant of a decreased emergence regime. It is possible that decreased emergence would allow the biotope to colonize further up the shore and extend its range.
Wave exposure changes - local increase	IMX.CreAph occurs in sheltered areas such as estuaries and is characterized by a mixed substratum (Connor et al., 1997a). This suggests that the biotope would be intolerant of wave exposure to some degree. An increase in wave exposure by two categories for one year would be likely to affect the biotope in several ways. Fine sediments would be eroded (Hiscock, 1983) resulting in the likely reduction of the habitat of the infaunal species and a decrease in food availability for deposit feeders. Gravel and cobbles are likely to be moved by strong wave action resulting in damage and displacement of epifauna. For example, *Crepidula fornicata* is often found cast ashore following storms (Hayward & Ryland, 1995). Species may be damaged or dislodged by scouring from sand and gravel mobilized by increased wave action. Furthermore, strong wave action is likely to cause damage or withdrawal of delicate feeding and respiration structures of species within the biotope resulting in loss of feeding opportunities and compromised growth. It is likely that high mortality would result and therefore an intolerance of high is recorded and species richness is expected to decline. Recoverability is recorded as high (see additional information below).
Wave exposure changes - local decrease	IMX.CreAph occurs in 'extremely sheltered' environments (Connor et al., 1997a). The species present thrive in low energy environments and are tolerant of changes in chemical factors such as dissolved oxygen and salinity. The biotope, therefore, is unlikely to be intolerant of a further decrease in wave exposure and species richness is unlikely to change.
Water clarity increase	None of the species in the IMX.CreAph biotope require light and so therefore are not likely to be affected by a decrease in turbidity for light attenuation purposes. However, a decrease in turbidity will mean more light is available for photosynthesis by phytoplankton in the water column and phytobenthos on the sediment surface. Over the course of a year, this may lead to the development of a community of macroalgae which could potentially compete with some of the epifaunal species in the biotope, resulting in some mortality. Intolerance is therefore recorded as intermediate and there may be a minor decline in species richness. Recoverability is recorded as high (see additional information below).

Water clarity decrease	IMX.CreAph occurs in turbid estuarine waters and therefore the species in the biotope are likely to be well adapted to turbid conditions. An increase in turbidity may affect primary production in the water column and therefore reduce the availability of diatom food, both for suspension feeders and deposit feeders. In addition, primary production by the microphytobenthos on the sediment surface may be reduced, further decreasing food availability for deposit feeders. However, primary production is probably not a major source of nutrient input into the system and, furthermore, phytoplankton will also immigrate from distant areas and so the effect may be decreased. As the benchmark turbidity increase only persists for a year, decreased food availability would probably only affect growth and fecundity of the intolerant species so a biotope intolerance of low is recorded. As soon as light levels return to normal, primary production will increase and hence recoverability is recorded as very high. There is not expected to be any mortality due to increased turbidity and hence the species richness is not expected to change.
Nutrient enrichment	Nutrient enrichment can lead to significant shifts in community composition in sedimentary habitats. Typically the community moves towards one dominated by deposit feeders and detritivores, such as polychaete worms (see review by Pearson & Rosenberg, 1978). The biotope includes several species tolerant of nutrient enrichment (e.g. *Nephtys hombergi*, *Eteone longa*, *Corophium volutator*) and typical of enriched habitats (e.g. *Tubificoides* sp., *Mediomastus fragilis*) (Pearson & Rosenberg, 1978). It is likely that these species would increase in abundance following nutrient enrichment, with an associated decline in suspension feeding species such as ascidians. The intolerance of the characterizing species *Aphelochaeta marioni* is difficult to ascertain from the available evidence. Raman & Ganapati (1983) presented evidence that *Aphelochaeta marioni* is not tolerant of eutrophication. However, nutrient enrichment would lead to increased food availability, the species is tolerant of low oxygen conditions (Broom et al., 1991) and has been recorded as proliferating following an oil spill which resulted in eutrophic conditions (Dauvin 1982, 2000). No information was found for the intolerance of *Crepidula fornicata* to nutrient enrichment. It seems likely that nutrient enrichment would result in a shift in community structure rather than a gross change in species composition and so biotope intolerance is recorded as intermediate, with a minor decline in species richness. Recoverability is recorded as high (see additional information below).
Habitat structure changes - removal of substratum (extraction)	The majority of species in the biotope live either permanently attached to the substratum (epifauna) or buried in the underlying sediment (infauna). The physical removal of the substratum, e.g. as a result of channel dredging activities, would also remove the associated populations. Therefore, intolerance is recorded as high. For example, Ismail (1985) demonstrated that following suction dredging of the top few centimetres of sediment on oyster grounds in Delaware Bay, the *Crepidula fornicata* population was removed. Substratum loss is likely to result in the complete eradication of most species and therefore species richness in the biotope will experience major decline. Hall & Harding (1997) reported that following suction dredging in soft sediments, the species richness of infaunal communities was reduced by up to 30% and the numbers of individuals by up to 50%. Recoverability is recorded as high (see additional information below).

Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	Both the epifaunal and the infaunal species in the biotope are likely to be sensitive to physical disturbance due to dredging for scallops or oysters. Soft bodied epifauna, such as ascidians, are most vulnerable, and are likely to suffer high mortality. Sponges and hydroids attached to the slipper limpet bed are likely to be removed along the dredge track. *Crepidula fornicata* has a robust body form and so individuals are likely to be resistant to the benchmark level of physical abrasion. However, the gregarious chain-forming characteristic of the species renders it susceptible to disturbance, as chains are more likely to be broken up, leaving some individuals exposed to predation. De Montaudouin et al. (2001) (following Sauriau et al., 1998) suggested that physical disturbance is a factor which could stimulate the presence of *Crepidula fornicata*. They noted that the species settles preferentially in the trails of trawl fishing gear, and that this may explain why *Crepidula fornicata* is not very abundant in the Arcachon Basin, France, as bottom trawling activities are prohibited here. The infaunal annelids are predominantly soft bodied, live within a few centimetres of the sediment surface and may expose feeding or respiration structures where they could easily be damaged by a physical disturbance such as a passing dredge. The species with robust exoskeletons, such as bivalves and crustaceans, are likely to be the most resistant. The overall, a proportion of the slipper limpet bed, and its associated epifauna and infauna are likely to be removed or displaced. Therefore, an overall intolerance of intermediate has been recorded. For recoverability see additional information below.
Siltation rate changes	The majority of species in the biotope live either infaunally or are capable of burrowing. They would be expected to tolerate an additional 5 cm layer of sediment and relocate to their preferred position. *Aphelochaeta marioni*, for example, deposit feeds at the surface by extending contractile palps from its burrow. The additional layer of sediment would result in a temporary cessation of feeding activity, and therefore growth and reproduction are likely to be compromised. However, *Aphelochaeta marioni* would be expected to quickly relocate to its favoured depth, with no mortality. The immobile epifauna in the biotope are likely to be more intolerant of smothering. Ascidians are active suspension feeders and rely on a through current of water for feeding and respiration. Smothering would be likely to cause severe inhibition of these activities and mortality would be expected to result within a few days. However, larger species such as *Ascidiella aspersa* would probably not be affected as they attach to protuberant surfaces and their siphons are a few centimetres clear of the sediment surface. *Crepidula fornicata* is also an active suspension feeder and it would be expected that the feeding and respiration structures would be susceptible to smothering. However, it has been demonstrated that *Crepidula fornicata* is capable of clearing its feeding structures at some energetic cost (Johnson, 1972). Furthermore, areas with large *Crepidula fornicata* populations do tend to become silted up through deposition of pseudofaeces, apparently with little effect on the species (Thouzeau et al., 2000) and the fact that *Crepidula fornicata* lives in chains of up to 12 individuals means that at least some of the chain would avoid the effects of smothering. Therefore, although there may be some energetic cost as a result of smothering, probably resulting in decreased growth and reproductive output, there is unlikely to be mortality. Given the intolerance of the characterizing species, the overall intolerance for the biotope is recorded as low but there is likely to be a minor decline in species richness due to mortality of the smaller ascidian species. Once the infaunal species have relocated to the surface and feeding and respiration structures have been

	cleared, activity should return to normal and therefore a recoverability of very high is recorded.
	The epifauna in the biotope are most likely to be affected by an increase in suspended sediment. *Crepidula fornicata* is an active suspension feeder, trapping food particles on a mucous sheet lying across the front surface of the gill filament. An increase in suspended sediment is therefore likely to interfere with the feeding and respiration structures. Johnson (1972) transplanted individual *Crepidula fornicata* to environments of varying turbidity and measured their shell growth rates. Growth rate was found to decrease as turbidity increased. These observations were verified in laboratory conditions by measuring water filtration rate at different turbidities. Filtration rate was found to decrease as turbidity increased with the greatest reduction in filtration occurring between 140-200 mg per litre. Decreased filtration rate was associated with increased production of pseudofaeces in order to keep the filtering mechanism clear of debris. Increased pseudofaeces production coupled with decreased food intake would lead to increased energy consumption that is likely to impair the survival of the species. The infauna and deposit feeders, such as *Aphelochaeta marioni*, are unlikely to be negatively affected by an increase in suspended sediment (Brenchley, 1981). An increased rate of siltation may result in an increase in food availability and therefore growth and reproduction may be enhanced. However, food availability would only increase if the additional suspended sediment contained a significant proportion of organic matter and the population would only be enhanced if food was previously limiting. Due to the intolerance of the suspension feeders, biotope intolerance is recorded as low. When suspended sediment returns to normal levels, feeding and respiration will return to normal and the only likely lag will be in reproductive output, i.e. it will take a period of time to replenish food reserves, during which reproductive output will not be at maximum levels. A recoverability of very high is therefore recorded.
	The majority of species in the biotope are either suspension feeders or deposit feeders and therefore rely on a supply of nutrients in the water column and at the sediment surface. A decrease in the suspended sediment would result in decreased food availability for suspension feeders. It would also result in a decreased rate of deposition on the substratum surface and therefore a reduction in food availability for deposit feeders. This would be likely to impair growth and reproduction. The benchmark states that this change would occur for one month and therefore would be unlikely to cause mortality. An intolerance of low is therefore recorded. As soon as suspended sediment levels increased, feeding activity would return to normal and hence recovery is recorded as immediate.
Visual disturbance	The majority of species in the biotope are unlikely to be affected by visual disturbance. However, Farke (1979) noted the intolerance of *Aphelochaeta marioni* to visual disturbance in a microsystem in the laboratory. In order to observe feeding and breeding in the microsystem at night, the animals had to be gradually acclimated to lamp light. Even then, additional disturbance, such as an electronic flash, caused the retraction of palps and cirri and cessation of all activity for some minutes. Visual disturbance, in the form of direct illumination during the species' active period at night, may therefore result in loss of feeding opportunities, which may compromise growth and reproduction. On the basis of the reaction of *Aphelochaeta marioni*, an intolerance of low is recorded. When the visual disturbance is removed feeding activity should return to normal

	immediately.
Introduction or spread of non-indigenous species.	Gibbs (1971) recorded that nearly all of the population of *Aphelochaeta marioni* in Stonehouse Pool, Plymouth Sound, was infected with a sporozoan parasite belonging to the acephaline gregarine genus Gonospora, which inhabits the coelom of the host. No evidence was found to suggest that gametogenesis was affected by Gonospora infection and there was no apparent reduction in fecundity. However, any parasitic infection is likely to impair the host in some way so the intolerance of the species is recorded as low. If the parasite were to be removed, the host would be likely to return to normal health quickly so a recoverability of very high is recorded. No information was found concerning infection of the other characterizing species, *Crepidula fornicata*, by microbial pathogens.
Introduction of microbial pathogens	The fauna in the biotope are all aerobic organisms and are therefore likely to be intolerant in some degree to lack of oxygen. No evidence was found for specific effects of reduced oxygenation on *Crepidula fornicata* but inferences can be drawn from the effects on other species. Jorgensen (1980) recorded the effects of low oxygen levels on benthic fauna in a Danish fjord. At dissolved oxygen concentrations of 0.2-1.0 mg/l the gastropod *Hydrobia ulvae* suffered mortality unless able to crawl to areas of higher oxygen concentration and the bivalves, *Cardium edule* and *Mya arenaria*, suffered mortality between 2 and 7 days. As *Crepidula fornicata* is not mobile, it is expected that some mortality would occur within a week at the benchmark level of 2 mg/l. Infaunal species which typically tolerate lower oxygen tensions than occur in the water column are likely to be less intolerant of reductions in dissolved oxygen. For example, Broom et al. (1991) recorded that *Aphelochaeta marioni* characterized the faunal assemblage of very poorly oxygenated mud in the Severn Estuary. They found *Aphelochaeta marioni* to be dominant where the redox potential at 4 cm sediment depth was 56 mV and, therefore, concluded that the species was tolerant of very low oxygen tensions. On the basis of the intolerance of epifauna such as *Crepidula fornicata*, the intolerance of the biotope is recorded as intermediate, with a minor decline in species richness. Recoverability is recorded as high (see additional information below).
Removal of target habitat	The biotope is dominated by *Crepidula fornicata* which is itself an alien species. It has spread widely through Europe following introduction from North America at the end of the 19th century (Fretter & Graham, 1981; Eno et al., 1997).
Removal of non-target habitat	IMX.CreAph is associated with oyster beds and relict oyster beds, (IMX.Ost), in southern England and Wales, separated from these by the superabundance of *Crepidula fornicata* (Connor et al., 1997b). *Crepidula fornicata* is a serious pest on oyster beds (Fretter & Graham, 1981) and therefore extraction of the species has occurred in an attempt to reduce the negative impact on the shellfishery in these areas. Cole & Hancock (1956) reported that over 8 tonnes/ha of slipper limpets were removed from oyster beds by dredging and that it takes up to 10 years to return to pre-clearance levels. Extraction of *Crepidula fornicata* would therefore be responsible for shifting the IMX.CreAph biotope back towards the IMX.Ost biotope from which it usually develops. Extent of the biotope would be expected to decrease and intolerance has therefore been recorded as intermediate. In this specific case, given the evidence for recovery time, recoverability is recorded as moderate. The effect of dredging for slipper limpets would be similar to removing the upper layer of the substratum and therefore a decline in species richness is expected.

2.26	Sheltered muddy gravel IMX.VsenMtru
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The temperature intolerance of the biotope is largely dependent on the intolerance of the important characterizing species. The geographic range of *Venerupis senegalensis* extends to northern Africa. Therefore, the species must be capable of surviving in higher temperatures than it experiences in Britain and Ireland and thus would be expected to tolerate temperature change over an extended period. A population of *Venerupis corrugatus* endured a temperature rise from 13 to 18°C over 5 hours in a rockpool and then a drop to 14°C following inundation by the tide, with no obvious ill effects (Stenton-Dozey & Brown, 1994). Albentosa et al. (1994) found that scope for growth of *Venerupis senegalensis* increases to an optimum at 20 °C and then declines. Hence, it is expected that *Venerupis senegalensis* would be able to tolerate a long term, chronic temperature increase and a short term acute change with no mortality. However, a rapid increase in temperature may result in sub-optimal conditions for growth and reproduction and therefore intolerance of the biotope is assessed as low. Metabolic activity should return to normal when temperatures decrease and so recoverability is assessed as very high. The intolerance of other species in the biotope is variable. Epifauna and macroalgae which occur in the intertidal tend to be quite tolerant of temperature change. *Littorina littorea*, for example, occurs in upper shore rockpools where temperatures may exceed 30°C. The infauna may be less tolerant of temperature change per se, e.g. upper median lethal temperature for *Cerastoderma edule* is 29°C after 96 hrs exposure (Ansell et al., 1981), but are less likely to experience rapid changes in temperature due to being buried in sediment.
Temperature changes - local decrease	The temperature intolerance of the biotope is largely dependent on the intolerance of the important characterizing species. The geographic range of *Venerupis senegalensis* extends to northern Norway. Therefore, the species must be capable of survival at lower temperatures than it does in Britain and Ireland and would be expected to tolerate a chronic temperature decrease over an extended period. However, in the harsh British winter of 1962-63, when the south coast experienced temperatures 5-6°C below average for a period of 2 months, *Venerupis senegalensis* (studied as *Venerupis pullastra*) suffered 50% mortality around the Isle of Wight and near 100% mortality in Poole Harbour (Waugh, 1964). The species is less tolerant therefore of acute decreases in temperature and a biotope intolerance of intermediate is recorded. Recoverability is recorded as high (see additional information below). Other species which suffered significant mortality during the winter of 1962-63 include *Cerastoderma edule*, *Ensis ensis* and *Gibbula cineraria* (Crisp, 1964). It is expected that there will be a minor decline in species richness in the biotope.

Salinity changes - local increase	The biotope occurs in fully saline conditions (Connor et al., 1997a) and therefore is not likely to be intolerant of increases in salinity. No information was found concerning the intolerance of the important characterizing species, *Venerupis senegalensis*, to hypersaline conditions. However, the intolerance to hypersalinity of some other species which occur in the biotope has been researched. For *Cerastoderma edule*, Russell & Peterson (1973) reported an upper median salinity limit of 38.5 psu. Rygg (1970) noted that a population of *Cerastoderma edule* did not survive 23 days exposure at 60 psu, although they did survive at 46 psu. When exposed to hyper-osmotic shock (47 psu), *Arenicola marina* lost weight, but were able to regulate and gain weight within 7-10 days (Zebe & Schiedek, 1996).
Water flow (tidal current) changes - local increase	IMX.VsenMtru occurs in wave protected areas where water flow is typically "weak" (Connor et al., 1997a). An increase in water flow of 2 categories would place the biotope in areas of "strong" flow. The increase would change the sediment characteristics in which the biotope occurs, primarily by re-suspending and preventing deposition of finer particles (Hiscock, 1983). The underlying sediment in the biotope has a high silt content; a substratum which would not occur in very strong tidal streams. Therefore, the infaunal species, such as *Venerupis senegalensis*, would be outside their habitat preferences and some mortality would be likely to occur, probably due to interference with feeding and respiration. Additionally, the consequent lack of deposition of particulate matter at the sediment surface would reduce food availability for the deposit feeders in the biotope. The resultant energetic cost over one year would also be likely to result in some mortality. A biotope intolerance of intermediate is therefore recorded and species richness is expected to decline. Recoverability is assessed as high (see additional information below). The expected change in sediment composition would favour the epifauna and macroalgae which would probably become more abundant.
Water flow (tidal current) changes - local decrease	IMX.VsenMtru occurs in low energy environments such as sheltered beaches where the water flow is typically "weak" (Connor et al., 1997a). The majority of species in the biotope are infaunal and are capable of generating their own respiration and feeding currents. These species are unlikely to be intolerant of a decrease in water flow rate. However, decreased water flow rate is likely to lead to increased deposition of fine sediment (Hiscock, 1983) and therefore decreased availability of suitable substrata for the attachment of macroalgae and epifauna. There may, therefore, be a minor decline in species richness in the biotope.
Emergence regime changes - local increase	The biotope occurs on the extreme lower shore (Connor et al., 1997a) and so is vulnerable to an increase in emergence. The fact that the biotope does not occur further up the shore suggests that the characterizing species must be limited by one or more factors including desiccation, temperature and wave exposure. The benchmark for emergence is an increase in exposure for one hour every tidal cycle for a year. During this time, exposed marine species will not be able to feed and respiration will be compromised. Over the course of a year, it is expected that the resultant energetic cost to the individuals highest up the shore will lead to some mortality and therefore intolerance is recorded as intermediate. Some species will be more sensitive than others. *Littorina littorea*, for example, is relatively tolerant of increases in emergence as it is mobile and has behavioural adaptations to counter desiccation. Recoverability is recorded as high (see additional information below).

Emergence regime changes - local decrease	The majority of the biotope occurs in the shallow subtidal (Connor et al., 1997a) and so is not likely to be intolerant of a decrease in emergence regime. It is possible that a decrease in emergence regime would allow the biotope to extend further up the shore.
Wave exposure changes - local increase	IMX.VsenMtru occurs in sheltered inlets and sea lochs and is characterized by a mixed substratum (Connor et al., 1997a). This suggests that the biotope would be intolerant of wave exposure to some degree. An increase in wave exposure by two categories for one year would be likely to affect the biotope in several ways. Fine sediments would be eroded (Hiscock, 1983) resulting in the likely reduction of the habitat of the infaunal species, e.g. *Venerupis senegalensis*, and a decrease in food availability for deposit feeders. Gravel and cobbles are likely to be moved by strong wave action resulting in damage and displacement of epifauna. Species may be damaged or dislodged by scouring from sand and gravel mobilized by increased wave action. For example, large macroalgae, such as *Fucus serratus*, are particularly vulnerable and are likely to suffer damaged fronds and dislodged plants. Furthermore, strong wave action is likely to cause damage or withdrawal of delicate feeding and respiration structures of species within the biotope resulting in loss of feeding opportunities and compromised growth. It is likely that high mortality would result and therefore an intolerance of high is recorded and species richness is expected to decline. Recoverability is recorded as high (see additional information below).
Wave exposure changes - local decrease	IMX.VsenMtru occurs in "extremely sheltered" environments (Connor et al., 1997a). The biotope, therefore, is unlikely to be intolerant of a further decrease in wave exposure and species richness is unlikely to change. However, it should be noted that decreased wave exposure will lead to changes in oxygenation and increased risk of smothering due to siltation. These factors are discussed in their relevant sections.
Water clarity increase	A decrease in turbidity will mean more light is available for photosynthesis by macroalgae, phytoplankton in the water column and microphytobenthos on the sediment surface. This would increase the primary production in the biotope and may mean greater food availability for grazers, suspension feeders and deposit feeders. There may be a consequent proliferation of epifauna and macroalgae at the expense the previously dominant infauna.
Water clarity decrease	IMX.VsenMtru occurs in relatively turbid waters and therefore the species in the biotope are likely to be well adapted to turbid conditions. An increase in turbidity may affect primary production in the water column and therefore reduce the availability of diatom food, both for suspension feeders and deposit feeders. In addition, primary production by the microphytobenthos on the sediment surface may be reduced, further decreasing food availability for deposit feeders. However, primary production is probably not a major source of nutrient input into the system and, furthermore, phytoplankton will also immigrate from distant areas so the effect may be decreased. As the benchmark turbidity increase only persists for a year, decreased food availability would probably only affect growth and fecundity of the intolerant species so a biotope intolerance of low is recorded. As soon as light levels return to normal, primary production will increase and hence recoverability is recorded as very high. Macroalgae are likely to be most affected by an increase in turbidity. There may therefore be a minor decline in species richness.

Habitat structure changes - removal of substratum (extraction)	Removal of the substratum would remove entire populations of infauna, epifauna and macroalgae. Intolerance is therefore assessed as high and there would be a major decline in species richness. Recoverability is assessed as high (see additional information below).
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	Many species in the biotope are vulnerable to physical abrasion. The infaunal annelids are predominantly soft bodied, live within a few centimetres of the sediment surface and may expose feeding or respiration structures where they could easily be damaged by a physical disturbance such as a scallop dredge. Despite their robust body form, bivalves are also vulnerable. For example, as a result of dredging activity, mortality and shell damage have been reported in *Mya arenaria* and *Cerastoderma edule* (Cotter et al., 1997). Robust bodied or thick shelled species were less sensitive, while species with brittle, hard tests are regarded to be sensitive to impact with scallop dredges (Kaiser & Spencer, 1995; Bradshaw et al., 2000). Epifauna and macroalgae risk being damaged and/or dislodged by physical abrasion. Some mortality is likely to result from physical abrasion so intolerance is recorded as intermediate and species richness may suffer a minor decline. Recoverability is assessed as high (see additional information below).
Siltation rate changes	*Venerupis senegalensis* typically burrows to a depth of 3-5 cm and is often attached to small stones or shell fragments by byssal threads. It is an active suspension feeder and therefore requires its siphons to be above the sediment surface in order to maintain a feeding and respiration current. Kranz (1972, cited in Maurer et al., 1986) reported that shallow burying siphonate suspension feeders are typically able to escape smothering with 10-50 cm of their native sediment and relocate to their preferred depth by burrowing. This is likely to apply to the proportion of the *Venerupis senegalensis* population which is not firmly attached by byssal threads. However, those individuals which are attached may be inhibited from relocating rapidly following smothering with 5 cm of sediment and some mortality is expected to occur. Emerson et al. (1990) examined smothering and burrowing of *Mya arenaria* after clam harvesting. Significant mortality (2-60%) in small and large clams occurred only at burial depths of 50 cm or more in sandy substrates. However, they suggested that in mud, clams buried under 25 cm of sediment would almost certainly die. Dow & Wallace (1961) noted that large mortalities in clam beds resulted from smothering by blankets of algae (Ulva sp.) or mussels (*Mytilus edulis*). In addition, clam beds have been lost due to smothering by 6 cm of sawdust, thin layers of eroded clay material, and shifting sand (moved by water flow or storms) in the intertidal. The more mobile burrowing infauna, such as polychaetes, are likely to be able to relocate to their preferred depth following smothering with little or no loss of fitness. Due to their requirement for light for photosynthesis, macroalgae, and especially the encrusting and low growing species such as the Corallinaceae, are likely to be highly intolerant of smothering. Due to the intolerance of the important characterizing species, *Venerupis senegalensis*, intolerance for the biotope is assessed as intermediate. Populations of epifauna and macroalgae may be lost so species richness is expected to decline. Recoverability is recorded as high (see additional information below).

	Venerupis senegalensis is an active suspension feeder, trapping food particles on the gill filaments (ctenidia). An increase in suspended sediment is therefore likely to affect both feeding and respiration by potentially clogging the ctenidia. In *Venerupis corrugatus*, increased particle concentrations between low and high tide resulted in increased clearance rates and pseudofaeces production with no significant increase in respiration rate (Stenton-Dozey & Brown, 1994). It seems likely therefore that *Venerupis senegalensis* would also be able to clear its feeding and respiration structures, although at high particle concentrations there may be some energetic cost. An energetic cost resulting from increased suspended sediment has also been suggested for other bivalves which occur in the biotope, for example *Mya arenaria* (Grant & Thorpe, 1991) and *Cerastoderma edule* (Navarro & Widows, 1997). According to the benchmark, the increase in suspended sediment persists for a month and no mortality of suspension feeders is expected in this time. Intolerance of the biotope is therefore assessed as low. When suspended sediment returns to original levels, metabolic activity should quickly return to normal and recoverability is assessed as very high. An increase in suspended sediment would probably result in an increased rate of siltation. The extent of substratum suitable for the epifauna in the biotope would decrease and encrusting macroalgae would become smothered. There is therefore likely to be a minor decline in species richness.
	The majority of species in the biotope are either suspension feeders or deposit feeders and therefore rely on a supply of nutrients in the water column and at the sediment surface. A decrease in the suspended sediment would result in decreased food availability for suspension feeders. It would also result in a decreased rate of deposition on the substratum surface and therefore a reduction in food availability for deposit feeders. This would be likely to impair growth and reproduction. The benchmark states that this change would occur for one month and therefore would be unlikely to cause mortality. An intolerance of low is therefore recorded. As soon as suspended sediment levels increased, feeding activity would return to normal and hence recovery is recorded as immediate.
Underwater noise changes	No information was found concerning the intolerance of the biotope or the characterizing species to noise. However, it is unlikely that the biotope will be affected by noise or vibrations caused by noise at the level of the benchmark.
Visual disturbance	The majority of the species in the biotope, including *Venerupis senegalensis*, have very little or no visual acuity, and are therefore unlikely to be intolerant of visual disturbance. Some species, however, respond to visual disturbance by withdrawal of feeding structures and are therefore likely to experience some energetic cost through loss of feeding opportunities. *Aphelochaeta marioni*, for example, feeds only at night, and responds to sudden light pollution by the retraction of palps and cirri and cessation of all activity for some minutes (Farke, 1979).
Introduction or spread of non-indigenous species.	Navas et al. (1992) investigated the parasites of *Venerupis senegalensis* (studied as *Venerupis pullastra*), from a population in south west Spain. The following were recorded: 36.6% prevalence of *Perkinsus atlanticus*; trophozoites found in the connective tissue of different organs with a very intensive hemocytic response, encysting the parasite and destroying tissue structure. 96.6% prevalence of ciliates in gills, including Trichodina sp. 11.8% prevalence of turbellarians. 11.1% prevalence of trematodes. *Perkinsus atlanticus* was also recorded as causing mortality in *Venerupis decussata* and *Venerupis aureus*. Freire-Santos et al. (2000) recorded the presence of oocysts of Cryptosporidium

	sp. in *Venerupis senegalensis* (studied as *Venerupis pullastra*) collected from north west Spain and destined for human consumption. Several parasites occur in *Mya arenaria*, e.g. cercaria of *Himasthla leptosoma*, the nemertean parasite Malacobdella sp. and the copepod *Myicola metisciensis* may be commensal (Clay, 1966). The protozoan, Perkinsus sp. has recently been isolated from *Mya arenaria* in Chesapeake Bay, USA (McLaughlin & Faisal, 2000). *Mya arenaria* is also known to suffer from cancers, disseminated neoplasia and gonadal tumours. Disseminated neoplasia, for example, has been reported to occur in 20% of the population in north eastern United States and Canada, and caused up to 78% mortalities in New England (Brousseau & Baglivo, 1991; Landsberg, 1996). Little information was found regarding microbial infection of polychaetes, although Gibbs (1971) recorded that nearly all of the population of *Aphelochaeta marioni* in Stonehouse Pool, Plymouth Sound, was infected with a sporozoan parasite belonging to the acephaline gregarine genus Gonospora, which inhabits the coelom of the host. No evidence was found to suggest that gametogenesis was affected by Gonospora infection and there was no apparent reduction in fecundity. The parasite loads of the bivalves discussed above have been proven to cause mortality and therefore a biotope intolerance of intermediate is recorded and there may be a minor decline in species richness in the biotope. Recoverability is recorded as high (see additional information below).
Introduction of microbial pathogens	The fauna in the biotope are all aerobic organisms and are therefore likely to be intolerant in some degree to lack of oxygen. Jorgensen (1980) recorded the effects of low oxygen levels on benthic fauna in a Danish fjord. At dissolved oxygen concentrations of 0.2-1.0 mg/l the bivalves, *Cerastoderma edule* and *Mya arenaria*, suffered mortality between 2 and 7 days. Rosenberg et al. (1991) reported 100% mortality of *Cerastoderma edule* exposed to 0.5 - 1.0 ml/l oxygen for 43 days and 98% mortality after 32 days. Intertidal and infaunal organisms tend to be more tolerant of anoxia. Zebe & Schiedek (1996) reported that *Arenicola marina* is able to respire anaerobically and survived 72 hrs of anoxia at 16°C. *Littorina littorea* can endure long periods of oxygen deprivation. The snails can tolerate anoxia by drastically reducing their metabolic rate (down to 20% of normal) (MacDonald & Storey, 1999). At the bench mark level of hypoxia (2 mg/l for 1 week) it is expected that some mortality of the more intolerant species, such as bivalves, would occur and therefore biotope intolerance is assessed as intermediate, with a minor decline in species richness. Recoverability is recorded as high (see additional information below).
Removal of target habitat	No information was found concerning the susceptibility of *Venerupis senegalensis* to invasive species. However, the American hard-shelled clam, *Mercenaria mercenaria*, colonized the niche left by *Mya arenaria* killed after the cold winters of 1947 and 1962/63 in Southampton Water (Eno et al., 1997). The *Mya arenaria* populations had not recovered in this area by 1997 (Eno et al., 1997). *Mya arenaria* often occurs in the IMX .VsenMtru biotope and therefore *Mercenaria mercenaria* may pose a threat of invasion. Biotope intolerance is therefore recorded as intermediate with a minor decline in species richness. Once *Mercenaria mercenaria* has invaded, displaced bivalve populations may never re-establish and hence recoverability is recorded as very low.

Removal of non-target habitat	*Venerupis senegalensis* is a very important commercial shellfish in Spain. It is harvested from the wild and raised in aquaculture (Jara-Jara et al., 2000). No information was found concerning the effect of harvesting on wild populations but it can be assumed that high mortality would occur in the intertidal where populations are more accessible to harvesters. The majority of the biotope occurs subtidally where it is less likely to be exploited. Dredging for *Venerupis senegalensis* may affect other species such as *Mya arenaria*. As a result of dredging activity, mortality and shell damage have been reported in *Mya arenaria* and *Cerastoderma edule* (Cotter et al., 1997). Other species in the biotope which are exploited commercially include *Arenicola marina* (Fowler, 1999), *Cerastoderma edule* (Hall & Harding, 1997), *Ensis ensis* (Fowler, 1999) and *Mya arenaria* (Emerson et al., 1990). Overall, an intolerance of intermediate is therefore recorded. Recoverability is recorded as high (see additional information below).

2.27	**Subtidal chalk IR.ALcByH**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Species that dominate this biotope are mainly widespread in the north-east Atlantic and, although there may be some change in dominant species (for instance, the southern species *Distomus variolosus* replacing the very similar *Dendrodoa grossularia*), the biotope is not expected to change greatly. Short term acute changes are not thought likely to have an adverse effect. Increase in temperature may encourage colonization by southern species that are currently rare or scarce, especially the cluster coral *Hoplangia durotrix* and the soft coral *Alcyonium hibernicum*.
Temperature changes - local decrease	Species that dominate this biotope are mainly widespread in the north-east Atlantic and, although there may be some change in dominant species (for instance, the northern species *Dendrodoa grossularia* replacing the very similar southern species *Distomus variolosus*, the biotope is not expected to change greatly. For recoverability, see Additional information below.
Salinity changes - local increase	The biotope and similar biotopes is found in full salinity, therefore a further increase in salinity is unlikely.
Water flow (tidal current) changes - local increase	The community in this biotope is predominantly of suspension feeding species. The passive suspension feeders at least are likely to especially benefit from increased flow of water and therefore increased supply of food. Increased flow of water will also remove silt. Overall, the effect is expected to be favourable to species richness and productivity. However, the species richness may decline if one or a small number of species become dominant as a result of the increased food supply.
Water flow (tidal current) changes - local decrease	The community in this biotope is predominantly of suspension feeding species. The passive suspension feeders at least are likely to be adversely affected by decreased flow of water and therefore decreased supply of food. Decreased flow of water may also allow silt to settle with the possibility of clogging feeding organs. Overall, the effect is expected to be unfavourable to species richness and productivity. For recoverability, see Additional information below.
Emergence regime changes - local increase	Although this biotope may be exposed to air during low water of spring tides, it is composed of species that are normally fully immersed. If emergence increased by the equivalent of a change in one zone in already lower shore examples of the biotope, several species would be likely to be killed. For recoverability, see Additional information below.
Emergence regime changes - local decrease	This biotope is normally fully submerged and would most likely benefit if occasional exposures to air ceased.

Wave exposure changes - local increase	The biotope occurs in wave exposed situations. In a location where increase in wave exposure was from moderately exposed to very exposed, the result would probably be an increase in species richness and abundance as suspension feeders will thrive and moderate grazing by urchins will still occur opening space for new colonization. However, if wave exposure increased to extremely exposed or was similar to that present in a surge gulley, a small number of species (especially colonial ascidians) may become dominant and displace other species. Any increase in wave exposure may mobilize nearby cobbles, pebbles or sand abrading at least the lower parts of the biotope near to the mobile substrata and reducing species richness to tolerant or fast growing species. Overall, intolerance is indicated as low but could be not sensitive* in some situations and high in others. For recoverability, see Additional information below.
Wave exposure changes - local decrease	The biotope occurs in wave exposed situations. In a location where a decrease in wave exposure was from exposed to sheltered or very sheltered, the result would probably be a decrease in species richness and abundance as suspension feeders thrive in moderately strong wave action. However, if wave exposure decreased from extremely exposed, additional species may colonize the biotope. Any decrease in wave exposure may reduce mobility of nearby cobbles, pebbles or sand reducing abrasion. Overall, intolerance is indicated as not sensitive* bearing in mind that the biotope is found in exposed and moderately exposed situations and would most likely remain the same biotope.
Water clarity increase	Decrease in turbidity may lead to colonization of the biotope with some algal species. However, since the biotope is in shaded situations, the algae are likely to occupy little space and not displace animal species. For recoverability, see Additional information below.
Water clarity decrease	The community is animal dominated and characterized so that reduction in light levels as a result of increased turbidity is not relevant. The biotope appears to thrive in moderately high turbidity conditions - for instance in North Devon (K. Hiscock, own observations). For recoverability, see Additional information below.
Habitat structure changes - removal of substratum (extraction)	The majority of characterizing and dominant species in this biotope are fixed to the substratum and, therefore, will be removed with the substratum. Intolerance is therefore high. For recoverability, see Additional information below.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	Erect epifaunal species are particularly vulnerable to physical disturbance. Hydroids and bryozoans are likely to be removed or damaged by bottom trawling or dredging (Holt et al., 1995). Veale et al. (2000) reported that the abundance, biomass and production of epifaunal assemblages decreased with increasing fishing effort. Hydroid and bryozoan matrices were reported to be greatly reduced in fished areas (Jennings & Kaiser, 1998 and references therein). The removal of rocks or boulders to which species are attached by the passage of mobile fishing gears (Bullimore, 1985; Jennings & Kaiser, 1998) results in substratum loss (see above). Magorrian & Service (1998) reported that queen scallop trawling removed emergent epifauna from horse mussel beds in Strangford Lough. They suggested that the emergent epifauna such as *Alcyonium digitatum* were more sensitive than the horse mussels themselves and reflected early signs of damage. However, *Alcyonium*

	digitatum is more abundant on high fishing effort grounds suggests that this seemingly fragile species is more resistant to abrasive disturbance than might be assumed (Bradshaw et al., 2000), presumably owing to good recovery due to its ability to replace senescent cells, regenerate of damaged tissue and early larval colonization of available substrata. Epifaunal ascidians are also likely to be removed by physical disturbance. Overall, physical disturbance by mobile fishing gear or equivalent force, is likely to remove a proportion of all groups within the community and attract scavengers to the community in the short term. Therefore, an intolerance of high has been recorded. Recoverability is likely to be high due to repair and regrowth of hydroids and bryozoans and recruitment within the community from surviving colonies and individuals (see additional information below). Severe physical disturbance will be similar in effect to substratum loss (see above).
	The most likely smothering event in this habitat is by other species, for instance, a dense settlement of a colonial ascidian over other species. Some existing species such as barnacles are likely to be killed as access to food and oxygen will be denied. Others, such as erect Bryozoa and Hydrozoa will protrude above the smothering. Since the community will be partially destroyed and the diversity reduced, intolerance is considered intermediate. For recoverability, see Additional information below.
Siltation rate changes	The species present in the biotope are mainly passive and active suspension feeders perhaps benefiting from suspended organic matter with the suspended sediment but also possibly adversely affected by clogging of feeding organs by increase in siltation. Overall, it is likely that minor adverse effects will occur due to clogging of feeding organs. Species are unlikely to be killed during a high suspended sediment of one month or so and recovery will be of condition only.
	The species present in the biotope are mainly passive and active suspension feeders feeding on planktonic organisms, perhaps benefiting from suspended organic matter with the suspended sediment. There might therefore be slightly less food but the adverse effects of silt clogging feeding organs would be removed so, on balance, no adverse effect is likely.
Visual disturbance	Species in the biotope are not sensitive to visual presence. Fish and crustaceans will probably react to shading be although not to the extent that change will occur.
Introduction or spread of non-indigenous species.	No information found.
Introduction of microbial pathogens	The biotope is characteristic of locations where water movement is vigorous and oxygenation high. However, where that water movement is brought about by wave action, periods of still weather could cause de-oxygenation at least in the enclosed part of the biotope. Effects of hypoxia have been observed in nooks and crannies of this biotope with species dead and decomposing (K. Hiscock, personal observations).
Removal of target habitat	There are no current non-native species that are known to occur in this biotope. However, future arrivals may include species that could dominate the habitat and displace native species.

Removal of non-target habitat	It is extremely unlikely that any of the species indicative of sensitivity would be targeted for extraction. However, potting for lobsters often occurs in this habitat and the action of laying and pulling the pots may scrape the surface of the rock (see Physical Disturbance above for further details. This may lead to the loss of various individuals since the majority of fauna associated with this biotope are sessile epifauna. An intolerance of intermediate has been suggested with a high recovery (see additional information).

2.27	**Subtidal chalk MCR.Pid**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The key structuring species in the biotope, *Pholas dactylus*, is a southern species and occurrence in Britain represents the northern limit of its range. Long term increases in temperature may allow the species to extend its geographical range further north. *Pholas dactylus* spawning appears to be temperature dependent and so a long term drop in temperature may cause *Pholas dactylus* to be replaced by piddocks tolerant of cooler water such as *Barnea candida* and *Zirfaea crispata* so the overall nature of the biotope is unlikely to change significantly. The other key species in the biotope extend into much cooler and warmer waters than found in Britain so are likely to be tolerant of long term changes in temperature.
Salinity changes - local increase	Many of the species in the biotope are found in the intertidal where some reduced salinity must be experienced from precipitation run-off. However, all species are fully marine species and a long term change in salinity is likely to be detrimental to most species. *Urticina felina*, a characterizing species in this biotope is likely to be highly intolerant of reductions in salinity.
Water flow (tidal current) changes - local increase	The biotope occurs in areas of weak to moderately strong water flow rates and so should be fairly tolerant of changes. Changes in water flow rate affect siltation levels and feeding of suspension and deposit feeders. *Pholas dactylus* occurs where the surface of the rock was scoured clean, and where it was covered with a layer of silty sediment (Wood & Wood, 1986). In areas of very strong tidal flow water movements may interfere with suspension feeding resulting in reduced growth and fecundity and the possible loss of some species is dependent on water movement for a supply of suspended particles which it uses to construct its tube. Reductions in water flow rate may reduce the amount of suspended sand grains available. This may limit growth of the worms or reduce the density of worms that can be supported in a particular area.

Emergence regime changes - local increase	The key species in the biotope (*Pholas dactylus*, *Polydora ciliata*, *Urticina felina* and *Halichondria panicea*) as well as many of the other species in the biotope are found intertidally (e.g. *Pomatoceros triqueter*, *Balanus crenatus* and *Molgula manhattensis*) and can tolerate some level of emergence. However, other species in the biotope, such as *Alcyonium digitatum* and *Tubularia indivisa* are entirely subtidal and would be highly intolerant of emergence. Thus, exposure of the biotope to an hour of air and sunshine may cause the loss of some species although the biotope as a whole would probably remain physically and functionally in tact. Recolonization of those species affected by emergence would probably be rapid as most have planktonic larvae, although the anemone *Urticina felina* has poor dispersal and takes a long time to recover. Recovery within five years should be possible. During this time the biotope will probably continue to exist albeit with slightly fewer species.
Wave exposure changes - local increase	The biotope is found in areas of moderate wave exposure. The chalk or clay habitat is soft and friable and an increase in wave exposure is likely to erode some of the substratum enabling only short lived species to survive. Species diversity is therefore likely to decline.
Water clarity decrease	The biotope is predominantly found in turbid waters and is therefore, likely to be tolerant of changes in turbidity. Few of the species are likely to be highly intolerant of changes in turbidity although decreases in turbidity may affect food supply to suspension feeding organisms impairing growth and fecundity. Resulting changes in light attenuation may affect the distribution of red algae often found in the biotope. On return to normal conditions recovery is likely to be good.
Habitat structure changes - removal of substratum (extraction)	The key structuring species, *Pholas dactylus*, is highly intolerant of substratum loss because once removed from its burrow it cannot excavate a new chamber and is likely to die. Recovery should be good because most characterizing species have planktonic larvae and so recolonization should be possible within five years.
Heavy abrasion, primarily at the seabed surface	Piddocks in burrows near the surface of the rock are likely to be damaged or killed by abrasion but many will be protected within their burrow. Some individuals of *Polydora ciliata* are also likely to be killed but surviving animals can migrate to affected areas. Species in the biotope that are upright and protrude above the substratum will also be damaged or killed (e.g. the sponge *Halichondria panicea*, hydroids, *Alcyonium digitatum* etc.). Therefore, an intolerance of intermediate has been recorded and species diversity will decline. Recovery will be good because most component species have pelagic larvae or can migrate into the area.
Light abrasion at the surface only	
Siltation rate changes	The key structural species *Pholas dactylus* is relatively tolerant of smothering by silt for it has been recorded from gently sloping chalk bedrock largely overlain by mud or silt 1-5cm deep, anoxic below the surface (Knight, 1984). *Polydora ciliata* is also found in areas of high siltation. However, many of the other species, such as *Urticina felina* and the many sessile suspension feeders like the sponge *Halichondria panicea*, though tolerant of turbid waters, are likely to be killed by a 5cm deep layer of silt. Species diversity can be expected to decline leaving a preponderance of *Pholas dactylus* and *Polydora ciliata*.

	The biotope occurs in silty turbid conditions so must tolerate or require some degree of siltation. *Polydora ciliata*, for example, requires suspended sediment in order to construct the tubes in which it lives and piddocks create sediment in the process of burrowing. Other species in the biotope, such as the sponge *Halichondria panicea*, the anemone *Urticina felina* and polychaetes *Pomatoceros triqueter*, *Sabellaria spinulosa* and *Lanice conchilega* are all tolerant of some siltation. A significant decrease in siltation levels may reduce food input to the biotope resulting in reduced growth and fecundity of suspension feeding animals. Conversely, increases in suspended sediment may benefit this species if availability of organic particles increases. However, very high levels of silt may clog respiratory and feeding organs of some suspension feeders such as sea squirts and may result in a minor decline in faunal species diversity.
Underwater noise changes	Although some species may respond to vibration the biotope as a whole is not likely to be affected by noise disturbance.
Visual disturbance	Most macro invertebrates have poor or short range perception and although some are likely to respond to shading caused by predators the biotope as a whole is unlikely to be sensitive to visual disturbance. However, the common piddock *Pholas dactylus* does react to changes in light intensity by withdrawing its siphon which may be an adaptive response to avoid predation by shore birds and fish (Knight, 1984).
Introduction or spread of non-indigenous species.	Insufficient information.
Introduction of microbial pathogens	Cole et al. (1999) suggest possible adverse effects on marine species below 4 mg/l and probable adverse effects below 2mg/l. Although *Pholas dactylus* may be tolerant of low oxygenation in an intertidal habitat, sub- tidal levels of 2mg/l for one week may be detrimental. On return to normal conditions however, recovery is likely to be rapid.
Removal of target habitat	The American piddock, *Petricola pholadiformis*, was introduced into Britain at the end of the nineteenth century, and is especially common in reduced salinity waters around the mouth of the Thames (Eno et al., 1997). It does not therefore seem likely to affect the MCR.Pid biotope. There is no information on other non-native species affecting the biotope.
Removal of non-target habitat	*Pholas dactylus* is known to be harvested in Britain although not to a great extent. In Italy, harvesting of piddocks has had a destructive impact on habitats and has now been banned (E. Pinn, pers. Comm. To MarLIN). In Britain, collection of piddocks is thought to have a similarly destructive effect. People have been known to go out onto the shore and, with the use of a hammer and chisel, excavate the piddocks from the soft rock (K. Hiscock, pers. Comm.). This would be catastrophic for the biotope. The stability of the soft rock would be reduced and potentially lead to the loss of the vast majority of piddocks that inhabit the top few centimetres of the substratum down to a depth of 10 cm. Farming methods are being investigated as an alternative and it is therefore possible that further targeted extraction could be a future possibility. If there is a continued increase in the marine aquarium trade for cold water species then *Urticina felina* could be a potential target species for extraction. *Urticina felina*

	is a slow growing anemone with poor dispersive abilities. It may take several years for recovery to occur but removal and recovery of this species may not have an important role in the viability and functioning of the biotope. Overall an intermediate intolerance has been suggested because extraction of piddocks is probably rare. Recoverability is likely to be high (see additional information).

2.27	**Subtidal chalk MCR.Pol**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Murina (1997) categorised *Polydora ciliata* as a eurythermal species because of its ability to spawn in temperatures ranging from 10.6-19.9°C. This is consistent with a wide distribution in north-west Europe which extends into the warmer waters of Portugal and Italy (Pardal et al., 1993; Sordino et al., 1989). In the western Baltic Sea Gulliksen (1977) recorded high abundances of *Polydora ciliata* in temperatures of 7.5 to 11.5°C and in Whitstable in Kent sea temperatures varied between 0.5 and 17°C (Dorsett, 1961). Although there was no information found on the maximum temperature tolerated by *Polydora ciliata* it does seem likely that the species is able to tolerate a long term increase in temperature of 2°C and may tolerate a short term increase of 5°C. However, growth rates may increase if temperature rises. For example, at Whitstable in Kent Dorsett (1961) found that a rapid increase in growth coincided with the rising temperature of the sea water during March. However, the species, and hence the biotope is likely to be more intolerant of a short term increase in temperature of 5°C and so intolerance is assessed as low. Recovery of the species will be very high because growth and fecundity will return to normal when conditions become more favourable.
Temperature changes - local decrease	Murina (1997) categorised *Polydora ciliata* as a eurythermal species because of its ability to spawn in temperatures ranging from 10.6-19.9°C. This is consistent with a wide distribution in north-west Europe. In the western Baltic Sea Gulliksen (1977) recorded high abundances of *Polydora ciliata* in temperatures of 7.5 to 11.5°C and in Whitstable in Kent abundance was high when winter water temperatures dropped to 0.5°C (Dorsett, 1961). Rapid changes in hydrographical conditions occurred when temperatures dropped from 11.5°C to 7.5°C in the course of 15 hours (Gulliksen, 1977) and so it appears the species is tolerant of short term changes in temperature. During the extremely cold winter of 1962/63 *Polydora ciliata* was apparently unaffected (Crisp (ed.), 1964). Intolerance of the biotope is therefore assessed as low because *Polydora ciliata* appears to be tolerant of both long and short term decreases in temperature. However, it is likely that growth and fecundity may be affected. The species will probably recover very rapidly on return to normal conditions.
Salinity changes - local increase	*Polydora ciliata* is a euryhaline species inhabiting fully marine and estuarine habitats. However, there are no records of the species or the biotope occurring in hypersaline waters and an increase for a period of a year is likely to result in the death of many individuals and so intolerance is reported to be high.

Water flow (tidal current) changes - local increase	*Polydora ciliata* was present and colonized test panels in Helgoland in three areas, two exposed to strong tidal currents and one site sheltered from currents (Harms & Anger, 1983) so the species appears to tolerate a wide range of water flow regimes. However, in very strong tidal currents little sediment deposition will take place resulting in coarse sediments retaining little organic matter and may become unsuitable for the deposit feeding and tube building activities of *Polydora ciliata*. However, where suspended sediment levels are high, deposition of fine sediment may occur even in strong flows providing suitable conditions for the species. Very strong water flows may sweep away Polydora colonies, often in a thick layer of mud on a hard substratum. If the species tube is embedded in a burrow excavated in limestone rock, shells or calcareous algae the animals may be protected from being washed away in increased flow. However, a change in water flow of 2 categories (see benchmark) for a period of a year is likely to interfere with feeding and tube building by removing sediments and may wash some individuals away. The viability of the biotope is likely to be reduced and so intolerance is set at intermediate. Recovery is high because the larvae of *Polydora ciliata* are planktonic and capable of dispersal over long distances and the reproductive period is of several months duration. In colonization experiments in Helgoland (Harms & Anger, 1983) *Polydora ciliata* settled on panels within one month in the spring.
Water flow (tidal current) changes - local decrease	*Polydora ciliata* was present and colonized test panels in Helgoland in three areas, two exposed to strong tidal currents and one site sheltered from currents (Harms & Anger, 1983) so the species appears to tolerate a wide range of water flow regimes. A decrease in water flow rate may reduce the suspended particulate material carried in the water column important for *Polydora ciliata* tube building and feeding. This may result in reduced viability of the population and so intolerance is assessed as low. On return to normal conditions recovery will be high because *Polydora ciliata* is able to rapidly recolonize suitable substrata.
Emergence regime changes - local increase	The biotope only occurs in the circalittoral zone (below 10 m) and is not subject to emergence.
Emergence regime changes - local decrease	The biotope only occurs in the circalittoral zone (below 10 m) that is not subject to emergence so a decrease is not relevant.
Wave exposure changes - local increase	The biotope is found in moderately wave exposed sites. If *Polydora ciliata* inhabits burrows within rocks it is unlikely to be damaged or removed by exposure to wave action. Feeding may be impaired in strong wave action and changes in wave exposure may also influence the supply of particulate matter. Polydora tubes normally form into 'mats' which are likely to be washed away if exposure were to increase by two exposure scales for a year. Intolerance is therefore, assessed as intermediate.

Wave exposure changes - local decrease	The biotope is found in moderately wave exposed sites. A decrease wave exposure may influence the supply of particulate matter for suspension feeding because wave action may have an important role in re-suspending the sediment that is required by the species to build its tubes. Food supplies may also be reduced affecting growth and fecundity of the species. Abundance of the species may decline if wave exposure decreases at the benchmark level so the intolerance of the biotope is regarded to be low.
Water clarity increase	A decrease in turbidity, increasing light availability may increase primary production by phytoplankton in the water column. However, productivity in the MCR.Pol biotope is secondary because *Polydora ciliata* deposit feeds on detritus or may suspension feed. Therefore, the biotope is not likely to be significantly affected by changes in turbidity and so intolerance is assessed as low. In estuaries and surf zones on the lower shore turbidity can be measured in g/l so the benchmark level is low in comparison. Nevertheless, primary production by pelagic phytoplankton and microphytobenthos do contribute to benthic communities and long term decreases in turbidity may increase the overall organic input to the detritus. Increased food supply may increase growth rates and fecundity of some species in the biotope.
Water clarity decrease	An increase in turbidity, reducing light availability may reduce primary production by phytoplankton in the water column. However, productivity in the MCR.Pol biotope is secondary because *Polydora ciliata* deposit feeds on detritus or may suspension feed. Therefore, the biotope is not likely to be significantly affected by changes in turbidity and so intolerance is assessed as low. In estuaries and surf zones on the lower shore turbidity can be measured in g/l so the benchmark level is low in comparison. Nevertheless, primary production by pelagic phytoplankton and microphytobenthos do contribute to benthic communities and so long term increases in turbidity may reduce the overall organic input to the detritus. Reduced food supply may affect growth rates and fecundity of some species in the biotope. However, at the level of the benchmark effects are not likely to be significant and a rank of low intolerance is reported. On return to normal turbidity levels recovery will be very high as food availability returns to normal.
Habitat structure changes - removal of substratum (extraction)	Removal of the substratum, perhaps by dredging, would result in the loss of *Polydora ciliata* tubes and hence the loss of the animals so intolerance is assessed as high. However, if some individuals remain, rapid recolonization is possible because the species is capable of tube building throughout its life. *Polydora ciliata* of all ages that were removed from their tubes on many occasions, all built new tubes (Daro & Polk, 1973). Recovery is likely to be high because the larvae of *Polydora ciliata* are planktonic and capable of dispersal over long distances and the reproductive period is of several months duration. In colonization experiments in Helgoland (Harms & Anger, 1983) *Polydora ciliata* settled on panels within one month in the spring.
Heavy abrasion, primarily at the seabed surface	As a soft bodied species, *Polydora ciliata* is likely to be crushed and killed by an abrasive force or physical blow. However, some individuals are likely to survive as individuals can withdraw into burrows and so intolerance has been assessed as intermediate. Recovery is good because *Polydora ciliata* has planktonic larvae that are capable of dispersal over long distances and the reproductive period is of several months duration. In colonization experiments in Helgoland (Harms & Anger, 1983) *Polydora ciliata* settled on panels within one month in the spring.
Light abrasion at the surface only	

	Polydora ciliata is probably relatively tolerant of smothering by 5 cm of sediment because the species inhabits a range of habitats including muddy sediment, larvae settle preferentially on substrates covered with mud (Lagadeuc, 1991) and worms can rebuild tubes close to the surface. The species also plays an important part in the process of temporary sedimentation of muds in some estuaries, harbours or coastal areas (Daro & Polk, 1973). Adults of *Polydora ciliata* produce a 'mud' resulting from the perforation of soft rock substrates (Lagadeuc, 1991). A Polydora mud can be up to 50cm thick, but the animals themselves occupy only the first few centimetres. They either elongate their tubes, or have left them to rebuild close to the surface.
Siltation rate changes	*Polydora ciliata* is able to inhabit a wide range of habitats from muddy sediments to soft rock. For example, the species is found in turbid waters with high levels of suspended sediment which it actively fixes in the process of tube making. Daro & Polk (1973) report that the success of Polydora is directly related to the quantities of muds of any origin carried along by rivers or coastal current. In the Firth of Forth *Polydora ciliata* formed extensive mats in areas that had an average of 68mg/l suspended solids and a maximum of approximately 680mg/l indicating the species is able to tolerate different levels of suspended solids (Read et al., 1982; Read et al., 1983). Occasionally, in certain places siltation is speeded up when *Polydora ciliata* is present because the species actually produces a 'mud' as it perforates soft rock and chalk habitats and larvae settle preferentially on substrates covered with mud (Lagadeuc, 1991). Therefore, it seems likely that the biotope will be not sensitive to increases in suspended sediment and siltation.
	Polydora ciliata is able to inhabit a wide range of habitats from muddy sediments to soft rock. Occasionally, in certain places siltation is speeded up when *Polydora ciliata* is present. Suspended sediment and siltation of those particles is important for tube building in *Polydora ciliata* so a decrease may reduce tube building or the thickness of the mud surrounding the 'colonies'. Daro & Polk (1973) report that the success of Polydora is directly related to the quantities of muds of any origin carried along by rivers or coastal currents. However, at the level of the benchmark the effects are not likely to be significant and an intolerance rank of low is recorded.
Underwater noise changes	*Polydora ciliata* may respond to vibrations from predators or bait diggers by retracting their palps into their tubes. However, the species is unlikely to intolerant of noise and so the biotope is assessed as not sensitive.
Visual disturbance	*Polydora ciliata* exhibits shadow responses withdrawing its palps into its burrow, believed to be a defence against predation. However, since the withdrawal of the palps interrupts feeding and possibly respiration the species also shows habituation of the response (Kinne, 1970). The species is, therefore, likely to have very low intolerance to visual disturbance and the biotope will be little affected by the presence of boats, humans or other factors not normally present in the marine environment.
Introduction or spread of non-indigenous species.	No information on diseases affecting *Polydora ciliata* or the biotope was found.

Introduction of microbial pathogens	*Polydora ciliata* is assessed as having low intolerance to oxygenation because the species is repeatedly found at localities with oxygen deficiency (Pearson & Rosenberg, 1978). For example, in polluted waters in Los Angeles and Long Beach harbours *Polydora ciliata* was present in the oxygen range 0.0-3.9 mg/l and the species was abundant in hypoxic fjord habitats (Rosenberg, 1977). The biotope contains no or few other species so the biotope as a whole will not be significantly affected by deoxygenation and so intolerance is assessed as low. Recovery is good because *Polydora ciliata* is able to rapidly recolonize suitable habitats.
Removal of target habitat	No known non-native species compete with *Polydora ciliata* and so the biotope is assessed as not sensitive. However, as several species have become established in British waters there is always the potential for this to occur.
Removal of non-target habitat	It is extremely unlikely that *Polydora ciliata* would be targeted for extraction and we have no evidence for the indirect effects of extraction of other species on this biotope. If dredging were to occur then some Polydora may be lost (see Physical Disturbance).

2.28	**Tideswept algal communities**
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Temperature affects photosynthetic rates, photosynthetic saturation points and growth in macroalgae, and may also show seasonal adaptation, with tolerance to high temperatures being lower in winter than summer in some species (e. g. laminarians), and photosynthetic rates of some red algae higher at low temperatures in winter or at high temperatures in summer (see Lüning, 1984, 1990 and Kain & Norton, 1990 for reviews). Refer to individual species reviews for details of temperature tolerance. Overall, the majority of macroalgal species found in the biotope are widely distributed in British waters, and many are found further south. Some species, e.g. *Chondrus crispus* occurs in the lower intertidal, exposed to a wider range of temperatures than in the subtidal, while *Halidrys siliquosa* and *Chondrus crispus* also occur in rock pools that are potentially exposed to high temperatures in sunlight at low tide. Therefore, the biotope will probably be little affected by long term changes in temperature in British waters, and *Halidrys siliquosa* and other species that are also found in the intertidal are probably tolerant of acute temperature change at the benchmark level. For example *Chondrus crispus* did not suffer adverse effects as a result of an 4.8 -8.5°C increase in temperature above average during the hot summer of 1983 (Hawkins & Hartnoll, 1985). However, to represent the physiological effects of temperature on growth and reproduction an intolerance of low has been recorded.
Temperature changes - local decrease	Temperature affects photosynthetic rates, photosynthetic saturation points and growth in macroalgae, and shows seasonal adaptation with photosynthetic rates of some red algae higher at low temperatures in winter or at high temperatures in summer (see Lüning, 1984, 1990 and Kain & Norton, 1990 for reviews). Refer to individual species reviews for details of temperature tolerance. Overall, the majority of macroalgal species found in the biotope are widely distributed in British waters, and many are found in northern Norway or within the Arctic circle. Some species, e.g. *Chondrus crispus* occurs in the lower intertidal, exposed to a wider range of temperatures than in the subtidal, while *Halidrys siliquosa* and *Chondrus crispus* also occur inn rock pools that are potentially exposed to low temperatures at low tide. For example, *Furcellaria lumbricalis* tolerated -5°C for 3 months with no mortality and Bird et al. (1979) concluded that growth would not be inhibited at 0°C. Pearson & Davison (1993) recorded that *Chondrus crispus* froze at -7.59°C when cooled slowly from 5°C and froze at -3.7°C when cooled rapidly. Therefore, the biotope will probably be little affected by long term changes in temperature in British waters, and *Halidrys siliquosa* and other species that are also found in the intertidal are probably tolerant of acute temperature change at the benchmark level. However, to represent the physiological effects of temperature on growth an intolerance of low has been recorded.
Salinity changes - local increase	This subtidal biotope is unlikely to be exposed to hypersaline conditions or effluents.

Water flow (tidal current) changes - local increase	*Halidrys siliquosa* communities were reported from the 'rapids approaches' in association with *Himanthalia elongata* and *Saccharina latissima* (studied as *Laminaria saccharina*), and may occur in association with *Laminaria digitata* in strongly flowing tidal streams (Lewis, 1964). *Halidrys siliquosa* decreases in abundance with increasing water flow, so that in tidal rapids with current speeds of 2-3m/sec (ca 6 knots), it is replaced by *Laminaria digitata*, *Laminaria hyperborea* and *Saccorhiza polyschides* communities (Lewis, 1964; Schwenke, 1971). The tolerance of red algae to water flow varies with species, so that some species may be lost, however, the understorey of red algae will probably survive but with an altered species composition. This biotope is found in weak to moderately strong tidal streams (Connor et al., 1997a). An increase from moderately strong to very strong will probably result in loss of *Halidrys siliquosa* and its replacement as the dominant canopy algae by *Laminaria hyperborea* or *Laminaria digitata* (Lewis, 1964) resulting in loss of the biotope. Therefore, an intolerance of high has been recorded. Recoverability has been assessed as high (see additional information below).
Water flow (tidal current) changes - local decrease	This biotope occurs from moderately strong to weak tidal streams (Connor et al., 1997). Therefore, the biotope is tolerant of weak tidal flows. However, a further decrease to negligible water flow may result in stagnant conditions and increased siltation of fine sediments. Macroalgae are dependant on water flow to maintain a supply of nutrients and to remove waste products. Stagnant or negligible flow may be detrimental to some species, e.g. *Chondrus crispus* and *Ahnfeltia plicata*, whereas others are able to tolerate very weak or negligible water flow, e.g. *Delesseria sanguinea* and *Furcellaria lumbricalis*. In addition, passive suspension feeders may not be able to obtain adequate food while the suspension feeding apparatus of other species may be clogged by increased siltation (see above). Loss of suspension feeding epiphytes would result in a decrease in species richness. Many of the associated animals are likely to be lost. Overall, it is unlikely that the biotope will survive and an intolerance of high has been recorded. Recoverability has been assessed as high.
Emergence regime changes - local increase	An increase in emergence will increase exposure of the biotope to air and hence desiccation (see above). Therefore, the upper extent of several species within the biotope, most notably *Halidrys siliquosa*, *Furcellaria lumbricalis* and *Saccharina latissima* and hence the upper extent of the biotope is likely to be reduced. Therefore, an intolerance of intermediate has been recorded. Recoverability has been assessed as high (see additional information below).
Emergence regime changes - local decrease	A decrease in emergence may allow the biotope to extent its range up the shore and out-complete other species adapted to higher levels of desiccation. Therefore, a rank of 'not sensitive*' has been recorded.

Wave exposure changes - local increase	This biotope occurs in moderate to low wave exposure. An increase in wave exposure at the benchmark level may expose the biotope to wave exposed or very wave exposed conditions. *Halidrys siliquosa* develops as a short, stunted turf in wave exposed pools (Moss & Lacey, 1963; Lewis, 1964) and Lewis, (1964) suggested it could tolerate strong water movement. However, the stunted form does not occur in this biotope. *Saccharina latissima* is highly intolerant of wave exposure. However, with increasing wave exposure *Halidrys siliquosa* / *Saccharina latissima* communities are replaced by *Laminaria digitata* or *Laminaria hyperborea* communities (Lewis, 1964). Strong wave action is likely to cause some damage to fronds resulting in reduced photosynthesis and compromised growth. Furthermore, individuals may be damaged or dislodged by scouring from sand and gravel mobilized by increased wave action (Hiscock, 1983). Increased wave action is likely to turn and move boulders and cobbles within the biotope, removing macroalgae and some sessile invertebrates. Therefore, the biotope is likely to be lost and an intolerance of high has been recorded. After a period of a year (see benchmark) the biotope is likely to recover from the remaining plants remnants and attached holdfasts, and a rank if high has been recorded.
Water clarity increase	Decreased turbidity increases the light available for photosynthesis and potentially increases growth rates of macroalgae. *Halidrys siliquosa* and sublittoral fringe algae are probably tolerant of high light levels and would probably benefit form increased light, allowing the biotope to extent its range to shallower water where possible. Understorey red algae may be subject to increased competition from shallow water algae, so that the species composition may change, however, the understorey layer will survive. Therefore, the biotope may extend its range and a rank of 'not sensitive*' has been recorded.
Water clarity decrease	Increased turbidity reduces the light available for photosynthesis and hence growth and reproduction in macroalgae. For example, *Saccharina latissima* (studied as *Laminaria saccharina*) was shown to have a critical light requirement for gametophyte fertilization, and show a restricted distribution on the northeast coast of England in areas affected by light attenuating pollution (Fletcher, 1996). Understorey algae, especially red algae are shade tolerant. Birkett et al. (1998b) suggested that the reduced light under kelp canopies and, by inference, large macroalgae canopies, allowed red algae to colonize shallower waters. Some red algae, such as *Delesseria sanguinea* and *Furcellaria lumbricalis* tolerate turbid waters; *Furcellaria lumbricalis* being growth saturated at very low light levels. Similarly, *Phyllophora truncata*, *Phycodrys rubens* and *Polysiphonia nigrescens* apparently widely replaced *Fucus* spp. communities below 2m in the Kiel Bight, presumably due to increased turbidity (Fletcher, 1996). The biotope occurs in shallow depths but *Halidrys siliquosa* often occurs as a usually dominant species deeper than the kelp forest suggesting tolerance of low light levels. While red algae are more tolerant, the species composition may change, favouring the most tolerant species, e.g. *Furcellaria lumbricalis*, however, some less tolerant algae may be lost. Therefore, an intolerance of intermediate has been recorded to represent a reduction in the downward extent of the biotope. Recoverability has been assessed as high (see additional information below).

Non-synthetic compound contamination (incl. heavy metals)	Holt et al., (1995, 1997) reported that fucoids and other algae were capable of retaining and concentrating heavy metals, so much so that *Fucus* spp. are used as indicators of heavy metal pollution. Alginates found in fucoids (and in *Halidrys siliquosa*) strip heavy metals and some radionuclides from seawater and store them in inert forms. Hence, adult plants are considered to be relatively tolerant of heavy metal contamination. However, younger stages may be more intolerant. For example iron ore dust interfered with the interaction between eggs and sperm in *Fucus serratus* (Boney, 1980; cited in Bryan, 1984). Bryan (1984) also reported that heavy metals retarded growth in brown algae and suggested that the general order for heavy metal toxicity in seaweeds is: Organic Hg > inorganic Hg > Cu > Ag > Zn > Cd > Pb. Cole et al. (1999) reported that Hg was very toxic to macrophytes. Heavy metals have been shown to effects on sporophyte development, growth and respiration in *Laminaria hyperborea* (Hopkin & Kain, 1978) and in *Laminaria digitata* (Axelsson & Axelsson, 1987). Cole et al. (1999) suggested that Cd was very toxic to Crustacea (amphipods, isopods, shrimp, mysids and crabs), and Hg, Cd, Pb, Cr, Zn, Cu, Ni, and As were very toxic to fish. Bryan (1984) reported sublethal effects of heavy metals in crustaceans at low (ppb) levels. Bryan (1984) suggested that polychaetes are fairly resistant to heavy metals, based on the species studied. Short term toxicity in polychaetes was highest to Hg, Cu and Ag, declined with Al, Cr, Zn and Pb whereas Cd, Ni, Co and Se were the least toxic. However, he suggested that gastropods were relatively tolerant of heavy metal pollution. Overall, there is little information specific to the species present in this biotope. *Halidrys siliquosa* is probably of low intolerance to heavy metals due to the presence of alginates, whereas laminarians may be more intolerant. Therefore, an intolerance of low has been recorded, albeit at very low confidence.
Non-synthetic compound contamination (incl. hydrocarbons)	This biotope is protected from the direct effects of oil spills due to its subtidal habit, although it may be exposed to water soluble components of the oil or oil adsorbed on to particulates. No information concerning the effects of oil on *Halidrys siliquosa* was found. However, Holt et al. (1997) suggested that other Fucales, *Fucus* sp. had limited intolerance to oil but noted that studies on long-term exposure were limited. *Saccharina latissima* (studied as *Laminaria saccharina*) was observed to show no discernible effects from oil spills, largely due to poor dispersion into the water column and high levels of dilution (Holt et al., 1995). O'Brien & Dixon (1976) suggested that red algae were the most sensitive group of algae to oil or dispersant contamination, possibly due to the susceptibility of phycoerythrins to destruction. Laboratory studies of the effects of oil and dispersants on several red algal species, including *Delesseria sanguinea* and *Plocamium cartilagineum*, concluded that they were all sensitive to oil/dispersant mixtures, with little difference between adults, sporelings, diploid or haploid life stages (Grandy, 1984; cited in Holt et al., 1995). Long term effects of continuous doses of the water accommodated fraction (WAF) of diesel oil were determined in experimental mesocosms (Bokn et al., 1993). Mean hydrocarbon concentrations tested were 30.1 μg/l and 129.4 μg/l. After 2 years, there were no demonstrable differences in the abundance patterns of *Chondrus crispus*. Kaas (1980; cited in Holt et al., 1995) reported that the reproduction of adult *Chondrus crispus* plants on the French coast was normal following the Amoco Cadiz oil spill. However, it

	was suggested that the development of young stages to adult plants was slow, with biomass still reduced 2 years after the event. O'Brien & Dixon (1976) also noted that hydrocarbon exposure reduced photosynthesis in algae. Oil spills and hydrocarbon exposure in the intertidal results in loss of gastropod or crustacean grazers (Southward, 1982; Suchanek, 1993). Loss of grazers may allow development of more ephemeral green algae and a change in the algal community. However, although Bokn et al., (1993) could not demonstrate direct effects of chronic hydrocarbon contamination in their mesocosms, they concluded that chronic effects of oil on *Littorina littorea* and perhaps other herbivores may require more than 2 years to develop. Overall, while the dominant brown algae is probably of low intolerance to hydrocarbon contamination, most red algae are probably highly intolerant. In addition, crustacean and gastropod grazers may be lost reducing species richness. Therefore, an intolerance of intermediate has been recorded to represent loss of a proportion of the community and probable changes in the algal composition. Recoverability has been assessed as high (see additional information).
Synthetic compound contamination (incl. pesticides, anti-foulants, pharmaceuticals)	Fucoids, are generally quite robust in terms of chemical pollution (Holt et al., 1995, 1997), e.g. *Fucus* sp. seems to thrive in TBT-polluted waters (Bryan & Gibbs, 1991). However, Rosemarin et al. (1994) stated that brown algae (Phaeophycota) were extraordinarily intolerant of chlorate, such as from pulp mill or brine electrolysis effluents (Holt et al., 1997). O'Brien & Dixon (1976) suggested that red algae were the most sensitive group of algae to oil or dispersant contamination, possibly due to the susceptibility of phycoerythrins to destruction. They also reported that red algae are effective indicators of detergent damage since they undergo colour changes when exposed to relatively low concentration of detergent. Smith (1968) reported that 10 ppm of the detergent BP 1002 killed the majority of specimens in 24hrs in toxicity tests, although *Ahnfeltia plicata* and *Chondrus crispus* were amongst the algal species least affected by the detergent used to clean up the Torrey Canyon oil spill. Laboratory studies of the effects of oil and dispersants on several red algal species, including *Plocamium cartilagineum*, concluded that they were all sensitive to oil/ dispersant mixtures, with little difference between adults, sporelings, diploid or haploid life stages (Grandy, 1984; cited in Holt et al., 1995). Cole et al. (1999) suggested that herbicides in urban or agricultural runoff, such as simazine and atrazine, were very toxic to macrophytes. Hoare & Hiscock (1974) noted that all red algae except *Phyllophora* sp. were excluded from Amlwch Bay, Anglesey, by acidified halogenated effluent discharge. The evidence suggests that in general red algae are very intolerant of synthetic chemicals. Crustacean members of the fauna (mesoherbivores) are likely to be intolerant of pesticides, such as ivermecten, dichlorvos and synthetic pythrethroids (Cole et al., 1999), the exact toxicity varying with location (concentration) and species. Ascidian larval stages were reported to be intolerant of TBT (Mansueto et al., 1993 cited in Rees et al., 2001). Rees et al. (1999; 2001) reported that the epifauna of the inner Crouch estuary had largely recovered within 5 years (1987-1992) after the ban on the use of TBT on small boats in 1987. Increases in the abundance of *Ascidiella* sp. and *Ciona intestinalis* were especially noted. Overall, the brown algae may be relatively robust, e.g. *Halidrys siliquosa*, to many but not all forms of synthetic chemical pollution, while the red algae and some fauna are

	probably particularly sensitive. Therefore, a proportion of the community is likely to be lost and an intolerance of intermediate has been recorded, although species richness may decline markedly. Recovery has been assessed as high (see additional information below).
Radionuclide contamination	No information found.
De-oxygenation	Reduced salinity affects rates of photosynthesis and respiration and influences temperature tolerance in macroalgae, depending on species. *Saccharina latissima* (studied as *Laminaria saccharina*) was the most tolerant of the laminarians, surviving down to 17psu, although its growth was severely retarded at 16 psu and plants did not survive below 8 psu (Kain, 1979). *Halidrys siliquosa* occurs in rock pools exposed to rainfall and is probably tolerant of short term reductions in salinity. Red algae vary in their ability to tolerant low salinities, e.g. *Chondrus crispus* grows optimally at 25-40psu but did not grow at 10 psu (Kain & Norton, 1990). *Furcellaria lumbricalis* forms extensive populations in the main basin of the Baltic Sea where salinity is 6-8 psu in the upper 60-70 m and its extension into the Gulfs of Bothnia and Finland is limited by the 4 psu isohaline (see review by Bird et al., 1991). Rietema (1993) examined ecotypic differences between North Sea and Baltic populations of *Delesseria sanguinea*. Optimal growth occurred in Baltic specimens at 19 -23 psu and North Sea specimens at 33 psu. North Sea specimens died at 7.5 - 11 psu. *Ahnfeltia plicata* occurs over a very wide range of salinities. The species penetrates almost to the innermost part of Hardanger Fjord in Norway where it experiences very low salinity values and large salinity fluctuations due to the influence of snowmelt in spring (Jorde & Klavestad, 1963). However, demographic evidence suggests that number of species of red algae declines with decreasing salinity (sooner than brown or green algae), with a marked decline below 20 psu (Kain & Norton, 1990). *Botryllus schlosseri* lives in enclosed waters including docks and in estuaries where salinity is variable. However, its absence from low salinity conditions in upper estuaries and lagoons suggests that colonies will be intolerant of low salinities. Gastropods that extend their range into the intertidal are probably tolerant of reduced salinities e.g. *Lacuna vincta* is found in a range of salinities and has been recorded in salinities as low as 12-13 psu. However, gastropods that are primarily subtidal (e.g. Helcion pellucidum and Tectura spp.) probably have a more limited tolerance of low salinities and may be lost from the biotope. Overall, the dominant macroalgal species within this biotope would probably survive exposure to variable salinity in the long term or reduced salinity in the short term (see benchmark). However, several species of red algae in particular may be lost as a result of a long term reduction in salinity. Similarly, a reduction in faunal diversity is associated with reduced salinity, so that a marked reduction in overall species richness may occur. The biotope will, however, probably survive. Therefore, an intolerance of low has been recorded. Recoverably has been assessed as very high, although species richness may take longer to return.

Nutrient enrichment	Macroalgae are probably nutrient, particularly nitrogen, limited during summer or high temperatures. Nutrients are generally abundant in the winter months in temperate climates. Slow growing species, such as *Furcellaria lumbricalis* and species that store nutrients in winter for growth in summer, such as *Delesseria sanguinea* and laminarians, are probably nutrient limited. However, moderate nutrient enrichment may stimulate macroalgal growth, e.g. *Halidrys dioica* and other algae exposed to 10% untreated sewage effluent in the field, resulted in increased gross productivity (Kindig & Littler, 1980). Increased nutrient enrichment and eutrophication can also result in increased sedimentation and turbidity (see above) due to increased suspended sediment and/or increased phytoplankton productivity. Studies of changes in the benthic algal community of the Skagerrak coast in the Baltic Sea, an area heavily affected by eutrophication, between 1960 and 1997, noted the disappearance of the red alga, *Polyides rotundus*, the increase of delicate red algae with foliaceous thalli, e.g. *Delesseria sanguinea* and *Phycodrys rubens*, and tougher red algae with foliaceous thalli, e.g. *Phyllophora* sp. (Johansson et al., 1998). Additionally, *Chondrus crispus* and *Furcellaria lumbricalis*, both species with tough thalli, decreased at the wave exposed sites, possibly due to competition from the more vigorous *Phycodrys rubens* and *Delesseria sanguinea*, but persisted at the sites with high sedimentation. Eutrophication also results in an increase in opportunistic, fast growing, ephemeral green algae (e.g. *Ulva*, spp.) and some brown algae (e.g. Ectocarpus spp.) at the expense of fleshy and/or perennial red algae resulting in dominance by relatively few algae and hence a reduction in species richness (see Fletcher, 1996 for review). Localities characterized by excess loading of nutrients exhibit a general reduction in the diversity and occurrence of brown and red algae and a corresponding increase in green algae, such as *Ulva* sp. (Fletcher, 1996). Epiphytic algae growing on *Halidrys siliquosa* may also increase in abundance resulting in smothering of their host algae. Overall, while moderate nutrient enrichment may be beneficial, the above evidence suggests that eutrophication could result in marked changes in the macroalgae and the associated community, and in extreme cases potentially resulting in loss of the biotope. Therefore, an intolerance of intermediate has been recorded. Recoverability has been assessed as high (see below).
Habitat structure changes - removal of substratum (extraction)	Removal of the substratum will result in removal of the entire community with the exception of mobile fish, which can probably avoid the factor. Therefore, an intolerance of high has been recorded. Recoverability has been assessed as high, although species diversity, especially epifauna may take longer to recover.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	This biotope is characterized by species tolerant of sediment abrasion, suggesting a tolerance of abrasion. However, physical disturbance by, e.g., an anchor or mobile fishing gear is likely to damage fronds and may remove some individuals, especially large macroalgae such as *Halidrys siliquosa* and *Saccharina latissima*. Therefore, an intolerance of intermediate has been recorded. Loss of the distal parts of the plants may entail loss of the epiphytes, resulting in loss of species richness. Recovery may be rapid, especially where the holdfasts or encrusting forms of species remain (e.g. *Chondrus crispus* or *Ahnfeltia plicata*) and has been assessed as high. Large scale physical disturbance, such as dredging, will have an

	impact similar to substratum removal (see above).
Siltation rate changes	*Halidrys siliquosa* and laminarians are large and unlikely to be smothered by 5cm of sediment (see benchmark). Similarly, erect turf forming red and brown algae, e.g. *Furcellaria lumbricalis*, *Ahnfeltia plicata*, *Chondrus crispus*, Dilsea carnosa, Dictyota dichotoma and *Delesseria sanguinea* are probably large enough to be unaffected. For example, *Ahnfeltia plicata* and *Furcellaria lumbricalis* are tolerant of sand cover (Dixon & Irvine, 1977). However, smaller or low lying algae may be adversely affected. Algal spores and propagules are adversely affected by a layer of sediment, which can exclude up to 98% of light (Vadas et al., 1992), although the germlings of *Halidrys siliquosa* can survive darkness for up to 120 days. Germlings and juveniles are likely to be highly intolerant of smothering and any associated scour. A layer of sediment is likely to interfere with settlement and attachment of spores, especially if smothering occurred during winter reproductive maxima for the dominant species. Therefore, it is likely that while adult plants of most species will survive, smaller species and overall recruitment in the community may be adversely affected. Therefore, an intolerance of intermediate has been recorded. Algal recruitment within the community is likely to be rapid, so a recoverability of high has been recorded.
	Increased suspended sediment levels will increase turbidity (see below). This biotope is exposed to sediment abrasion and, therefore, characterized by species tolerant of siltation and sediment scour. Most species within the biotope are, therefore, probably tolerant. For example, Johansson et al. (1998) reported that *Furcellaria lumbricalis* persisted in areas of the Baltic Sea where eutrophication resulted in high sediment loads. However, algal propagules and germlings are probably more intolerant (Vadas et al., 1992).Adult *Saccharina latissima* (studied as *Laminaria saccharina*) plants appear to tolerate silt because they are found in areas of siltation (Birkett et al., 1998b) , but they cannot tolerate heavy sand scour and the gametophytes and spores are probably more intolerant. An increase in the level of suspended sediment was found to reduce the growth rate of *Saccharina latissima* (studied as *Laminaria saccharina*) by 20% (Lyngby & Mortensen, 1996) and Norton (1978) found that siltation of settled spores inhibited development of gametophytes and spores failed to form an attachment when settling out on silty surfaces. Overall, therefore most members of the community would probably survive increased suspended sediment levels, whereas a few species, most notably *Saccharina latissima* may be adversely affect, although in a months duration (see benchmark) probably not destroyed. Therefore, an intolerance of low has been recorded. Increased suspended sediment may interfere with suspension feeding apparatus of several epiphytic or sessile invertebrates, resulting in a reduction in species richness. Recoverability has been recorded as very high (see additional information below).

	Decreased suspended sediment levels will decrease turbidity (see below). This biotope is exposed to sediment abrasion and, therefore, characterized by species tolerant of siltation and sediment scour. A decrease in suspended sediment and hence scour may allow other species to invade the biotope, for example, laminarians. This biotope is similar to MIR.XKScrR, which suffers less scour and is characterized by lower abundance of *Halidrys siliquosa* but higher abundance of *Saccharina latissima* and *Laminaria hyperborea*. Long term decreases would probably result in an increase in laminarian abundance, eventually out-competing *Halidrys siliquosa* and the biotopes replacement by MIR. XKScrR or other laminarian dominated biotopes. The biotope is probably highly intolerant of changes in suspended sediment in the long term. However, a decrease in suspended sediment for a month (see benchmark) is likely to have little adverse effect and an intolerance of low has been recorded with a recoverability of very high.
Introduction or spread of non-indigenous species.	*Halidrys siliquosa* supports a number of epiphytic species, which use it as a substratum but are not parasitic on the plant. Gall formation may occur in response to bacterial or nematode infection in *Ahnfeltia plicata* and *Furcellaria lumbricalis* respectively. Growth rates of *Saccharina latissima* may be reduced by Streblonema disease. Growth and reproduction of *Chondrus crispus* may be reduced by fungal infections, epiphytic algae and bacteria. Little other information was found regarding diseases in macroalgae, and their effects on the biotope as a whole are difficult to assess. However, given the potential reduction in growth and reproduction due to disease an intolerance of low has been recorded, albeit at low confidence. Recoverably is probably very high (see additional information below).
Introduction of microbial pathogens	The effects of reduced oxygen levels of plants has been little studied. Reduced oxygen concentrations inhibit both photosynthesis and respiration (see review by Vidaver, 1972). The effects of decreased oxygen concentration equivalent of the benchmark would be greatest during dark when the macroalgae are dependant on respiration. A study of the effects of anoxia on *Delesseria sanguinea* revealed that specimens died after 24 hours at 15°C but that some survived at 5°C (Hammer, 1972). However, no other information was found.
Removal of target habitat	*Halidrys siliquosa* has been reported to be displaced as the dominant species in rock pools by the non-native *Sargassum muticum* on the south coast of England (Eno et al., 1997). Staehr et al. (2000) reported that an increase in the abundance of *Sargassum muticum* in Limfjorden, Denmark had resulted in a significant decline of the cover of large brown algae, especially *Saccharina latissima* (studied as *Laminaria saccharina*), *Halidrys siliquosa*, *Codium fragile* and *Fucus* vesiculosus. It seems that *Sargassum muticum* occurs in similar locations to *Halidrys siliquosa* and even attracts similar epibiota. However, although it may be more vigorous than *Halidrys siliquosa* it dies back in winter whereas *Halidrys siliquosa* persists. Although, *Halidrys siliquosa* plants are likely to remain, *Sargassum muticum* appears to be able to significantly reduce the extent of *Halidrys siliquosa* and other algae, particularly in shallow waters. Therefore, an intolerance of intermediate has been recorded. Recoverability has been assessed as high (see additional information below).

Removal of non-target habitat	No evidence of the extraction or harvesting of *Halidrys siliquosa* was found. Svendsen (1972; summary only) reported that *Halidrys siliquosa* became one of the dominant macroalgae, 3 years after kelp harvesting in Norway. This suggests that removal of other algae species that compete with *Halidrys siliquosa* for space and light would be beneficial. Commercial utilization of *Furcellaria lumbricalis* is based on the gelling properties of its extracted structural polysaccharide, furcellaran (Bird et al., 1991). Extraction of *Furcellaria lumbricalis* was reviewed by Guiry & Blunden (1991). Commercial beds of *Furcellaria lumbricalis* occur in Denmark where the algae are harvested with purpose built trawl nets, whereas in the rest of Europe, the biomass is not sufficient for harvesting. In Denmark, harvesting reached its highest level of 31,000 t p.a. in 1962, but over-exploitation has led to a fall in production and the current harvest is about 10,000 t p.a. Christensen (1971) (cited in Bird et al., 1991) and Plinski & Florczyk (1984) noted that over-exploitation of *Furcellaria lumbricalis* has resulted in severe depletion of stocks. A sustainable harvest of *Furcellaria lumbricalis* occurs in Canada on the shores of the Gulf of St Lawrence where dredging and raking are prohibited and only storm cast plants may be gathered. However, no commercial harvest as yet occurs in Britain or Ireland. *Chondrus crispus* is extracted commercially in Ireland, but the harvest has declined since its peak in the early 1960s (Pybus, 1977). The effect of harvesting has been best studied in Canada. Sharp et al. (1986) reported that the first drag rake harvest of the season on a Nova Scotian *Chondrus crispus* bed removed 11% of the fronds and 40% of the biomass. Efficiency declined as the harvesting season progressed. Chopin et al. (1988) noted that non-drag raked beds of *Chondrus crispus* in the Gulf of St Lawrence showed greater year round carposporangial reproductive capacity than a drag raked bed. Commercial exploitation of the red seaweeds which characterize the biotope has the potential to impact the community greatly, through changes in community structure and physical disturbance of the other species present. On balance, intolerance has been assessed as intermediate because even though the important characterizing species (*Halidrys siliquosa*) may benefit from the loss of other species, the other species may experience a decline. Recoverability has been assessed as high (see additional information below). It should be noted that large scale commercial harvesting in the biotope does not currently occur in Britain or Ireland.

3.1A	***Alkmaria romijni***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local	The temperature resistance of *Alkmaria romijni* has been investigated by Nausch (1984) who found that the species had a wide range of temperature resistance. Only 50 per cent of individuals died after 24 hours at 40 degrees centigrade at a salinity of 5 parts per thousand. The temperature resistance of *Alkmaria romijni* increases as salinity rises from 5 to 20 psu (Nausch, 1984).
Salinity changes - local	The species occurs in habitats subject to variation at different scales, e.g. tidal, seasonal. It is also found in sites with a range of recorded salinities. However, it may be affected change s outside of the normal range for a site and records of specimens above 20 psu are uncommon.
Water flow (tidal current) changes - local	Increased water flow could partly uncover adults and remove some individuals from the substratum. These individuals may not then re-establish themselves if deposited back onto the substratum. A long term change in the water flow may also result in a shift of sediment type from mud to a sediment of greater grain size. This would remove the preferred habitat of the species.
Emergence regime changes - local	*Alkmaria romijni* is probably able to tolerate some level of emergence because it has a mud tube, which is able retain water well. However, Gilliland & Sanderson (2000) suggest that the species is unable to tolerate long periods of emersion based on its low shore position in estuarine sites. In situations where likely to be exposed to this factor, i.e. lagoons, the species is likely to be present in deeper parts of the site, providing source of recolonization.
Wave exposure changes - local	*Alkmaria romijni* occurs in ultra sheltered to sheltered conditions (Gilliland & Sanderson, 2000). An increase in wave exposure to moderately exposed or greater could uncover or wash away adults and remove them from their preferred habitat range. It may also cause a shift in the sediment type from mud to sediment of a greater grain size and so remove the species' preferred habitat.
Water clarity changes	There is no evidence of dependence on light availability, as the species feeds only on detritus, therefore it is unlikely to be affected by a change in turbidity.
Habitat structure changes - removal of substratum (extraction)	*Alkmaria romijni* live in mud tubes in the surface of the sediment, which would be removed upon substrate loss. It is not known whether adults would be able to burrow to the surface to re-establish themselves on burial. Recovery is probably very low because adults would be unable to recruit in from elsewhere, as populations of *Alkmaria romijni* are often separated by great distances. The dispersal potential of larvae is also restricted because larvae are benthic.
Heavy abrasion, primarily at the seabed surface	*Alkmaria romijni* lives in the top 1-2 cm of the sediment which would be disturbed by physical disturbance caused by a passing scallop dredge or equivalent disturbance. Individuals in direct contact with the disturbance causing impact are likely to be damaged and/or killed, however, *Alkmaria*

Light abrasion at the surface only	*romijni* is very small so that a proportion of the population is likely to be missed or displaced. Therefore, an intolerance of intermediate has been recorded.
Siltation rate changes	It is not known whether adults would be able to move up through the sediment to the surface upon smothering, therefore smothering may prevent them from feeding as their tentacles would be trapped within the sediment. Larvae are benthic and therefore have low dispersal potential, restricting recovery.

3.2	***Amphianthus dohrnii***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local	General observations on sea anemones show mortalities at raised temperatures. A short term increase of 5°C is likely to kill some individuals of a population. A decrease in temperature may inhibit growth or reproduction. Longer term temperature increases are unlikely to affect British populations as the species extends down into the western Mediterranean. However, the host species (e.g. *Eunicella verrucosa*, *Swiftia pallida*) are more likely to be intolerant of change in temperature, as low temperatures are thought to affect recruitment. Very little is known about the larval and reproductive biology of this species. It is probably long lived. Reproduction is by asexual fission. The presence of adults means that recovery is not dependent on recolonization. The host species also has to recover to permit recovery of *Amphianthus dohrnii*.
Salinity changes - local	This species only lives in fully saline habitats. A reduction of salinity to lower than 30psu will cause the species to be exposed to conditions outside its preferred range. The host species also only lives in fully saline environments. Very little is known about the larval and reproductive biology of this species. It is probably long lived. Reproduction is by asexual fission. The presence of adults means that recovery is not dependent on recolonization. The host species also has to recover to permit recovery of the anemone.
Water flow (tidal current) changes - local	Occurs in weak to moderately strong water flow rates. A large change in water flow is likely to cause the species to exist in conditions outside its habitat preferences (water flow rates of <1 knot or >3 knots), causing some individuals of a population to die. The host species (e.g. *Eunicella verrucosa*, *Swiftia pallida*) are likely to be intolerant of change in wave exposure. Very little is known about the larval and reproductive biology of this species. It is probably long lived. Reproduction is by pedal/basal laceration. The presence of adults means that recovery is not dependent on recolonization by larval forms. The host species also has to recover to permit recovery of *Amphianthus dohrnii*.
Emergence regime changes - local	Found below 10 metres in depth so exposure to an emergence regime is highly unlikely.
Wave exposure changes - local	Found in quite a wide range of wave exposures. With the exceptions of extreme shelter and exposure, a change in wave exposure is unlikely to mean the species is exposed to conditions outside its preferred range. However, the host species (e.g. *Eunicella verrucosa*, *Swiftia pallida*) are more likely to be intolerant of change in wave exposure. Very little is known about the larval and reproductive biology of this species. It is probably long lived reproduction is by asexual fission. The presence of adults means that recovery is not dependent on recolonization. The host species also has to recover to permit recovery of *Amphianthus dohrnii*.
Water clarity changes	No dependence on light availability. Found down to 1000 metres where effectively no light is available.

De-oxygenation	Cole *et al*. (1999) suggest possible effects on marine species below 4 mg/l and probable effects below 2mg/l of oxygen. There is no information about the tolerance of *Amphianthus dohrnii* to changes in oxygenation. The host species may be intolerant of reduced oxygen levels. Very little is known about the larval and reproductive biology of this species. It is probably long lived. Reproduction is by asexual fission. The presence of adults means that recovery is not dependent on recolonization. The host species also has to recover to permit recovery of *Amphianthus dohrnii*.
Nutrient enrichment	Insufficient information
Heavy abrasion, primarily at the seabed surface	*Amphianthus dohrnii* is epifaunal, soft bodied and highly likely to be killed by physical disturbance. The host species (usually sea fans) are also likely to be intolerant of abrasion. Very little is known about the larval and reproductive biology of this species. It is probably long lived. Reproduction is by asexual fission. Occasional sexual reproduction must occur producing dispersive larvae and it is only this that would allow recolonization of areas where there are no more adults. The host species also has to recover in order for a suitable substratum to be available for recolonization.
Light abrasion at the surface only	
Siltation rate changes	As the chosen bench mark figure for smothering is defined as being covered by 5cm of sediment, this species itself is unlikely to be subject to smothering as it occupies a substratum above the seabed. Host species such as *Eunicella verrucosa* and *Swiftia pallida* are unlikely to be badly affected by smothering so effects on *Amphianthus dohrnii* will be negligible. However if large volumes of spoil were dumped near to/on this species and its host the consequences could be fatal.
	The species feeding apparatus may be partially clogged by increased siltation. An energetic cost will be expended in trying to clear this. The host species may be slightly affected but probably insufficiently to affect the anemone. Recovery starts as soon as normal feeding recommences.
Introduction or spread of non-indigenous species	Insufficient information
Introduction of microbial pathogens	Insufficient information
Removal of target species	Extraction of this species is unlikely and it is protected under a UK Species Action Plan.
Removal of non-target species	Extraction of host species is unlikely. *Eunicella verrucosa* is also protected under a UK Species Action Plan.

3.3	***Arachnanthus sarsi***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Salinity changes - local increase	*Arachnanthus sarsi* is found in full saline conditions and it is unlikely that it would be exposed to hypersaline conditions; therefore, not relevant has been recorded.
Salinity changes - local decrease	*Arachnanthus sarsi* is found only in fully saline conditions so it is likely that the sea pen would be intolerant of a decrease in salinity. Therefore an intolerance of high has been recorded. A recoverability of low has been recorded, resulting in a high sensitivity value.
Wave exposure changes - local increase	Another burrowing anemone, *Cerianthus lloydii*, has been observed to clump its tentacles in swell, and progressively withdraw with increasing flow velocity, up to a threshold level of 2-3 knots, after which the anemone completely withdraws into the sediment (Eleftheriou & Basford, 1983).
Wave exposure changes - local decrease	*Arachnanthus sarsi* is likely to be tolerant of a decrease in wave exposure. Recovery is likely to be immediate; therefore the species has been assessed as not sensitive.
Water clarity increase	*Arachnanthus sarsi* is not known to be sensitive to light, so is unlikely to be affected by a decrease in turbidity. However specimens growing in shallow waters (10 m) may experience competition for space with algae as a result of increase light penetration. A reduction in turbidity may also mean reduced food availability for the anemone. Therefore tolerance is assessed to be intermediate. Recovery is likely to be high; hence low sensitivity has been recorded.
Water clarity decrease	An increase in turbidity may provide additional food for *Arachnanthus sarsi*, therefore the species has been assessed tolerant, and not sensitive.
De-oxygenation	There is no evidence was found on the tolerance of *Arachnanthus sarsi* to deoxygenation. Jones et al. (2000) found that burrowing infaunal species generally require well oxygenated conditions. Burrowing megafauna were absent from de-oxygenated areas which are characterised by nutrient enrichment resulting in a hypoxic bacterial community, so are likely to be affected by aquaculture wastes. Deoxygenation has been found to kill the burrowing anemone *Pachycerianthus multiplicatus* (Hughes, 1998a). Therefore intolerance has been recorded as intermediate. A recoverability of moderate has been recorded, resulting in a moderate sensitivity assessment.
Nutrient enrichment	No information could be found on the effects of nutrient enrichment on *Arachnanthus sarsi*. It is possible that an increase in nutrients will result in greater food availability, as the anemone feeds on plankton. However any deoxygenation associated with the decomposition of organic material is likely to be damaging to *Arachnanthus sarsi*, as this has been found to kill the burrowing anemone *Pachycerianthus multiplicatus* (Hughes, 1998a).
Visual disturbance	*Arachnanthus sarsi* withdraws rapidly into the sediment on disturbance. This may result in a slight energetic cost, but is not likely to be significant at the level of the benchmark. Therefore tolerant has been recorded. Recovery may involve small energy losses in extending tentacles, so is assessed to be very high, therefore the species is not sensitive to this factor.

3.4	***Arctica islandica***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	An increase in temperature may affect spawning and recruitment levels. Kennish & Lutz (1995; cited in Cargnelli *et al.,* 1999a) attributed low recruitment to adverse environmental factors such as high temperatures. In the North Sea, *Arctica islandica* are restricted to north of 53°30'N and have never been reported south of this latitude (Witbaard & Bergman, 2003). This southern limit coincides with a 30 m depth contour, which borders the southern most limit of the summer stratified water mass of the Oyster Ground, where bottom water temperatures never exceed 16°C. Larvae here can successfully develop but conditions for development and survival deteriorate along the southern margins of the North Sea (Witbaard & Bergman, 2003). Similarly, the inshore limit of *Arctica islandica* in the eastern USA was reported to be the 16°C bottom isotherm (Cargnelli *et al.*, 1999a). Laboratory studies have shown that larvae and juveniles can survive temperatures as high as 20°C, although larvae tend to grow optimally between 13°C - 15°C (Cargnelli *et al.,* 1999a). Field studies off Massachusetts observed the highest concentrations of larvae between August and September at temperatures of 14 -18°C (Cargnelli *et al.,* 1999a). Merrill *et al.* (1969) reported that adults died in a few days at 21°C in the laboratory. It was stated that it was difficult to keep adult specimens alive long enough to transport them to market in the summer months in the USA, which suggested a low tolerance of high temperatures. It was also suggested that an intolerance of high temperatures might explain their absence form shallow waters in the southern extent of its range (Merrill *et al.*, 1969). Therefore, an increase in temperature at the benchmark level may adversely affect larval recruitment and/or adult survival, potentially restricting their southern most extent. Hence an intolerance of high has been recorded. For recoverability, see additional information below. Therefore, intolerance has been assessed as intermediate, with moderate recoverability. See additional information below for recoverability information.
Temperature changes - local decrease	*Arctica islandica* is a temperate, boreal cold water species. Cargnelli *et al.* (1999a) reported that juveniles could grow at temperatures as low as 1°C, while other estimates suggested an optimal temperature range for adults of 6 -16°C. It is likely to be tolerant of lower temperatures than it experiences around the British Isles, since it also occurs as far north as the Faeroes and the White Sea. Therefore, intolerance has been assessed as tolerant and recoverability rates are not considered as relevant.
Salinity changes - local increase	Larval *Arctica islandica* were collected at mean salinities of 32.4 ppt in the USA, while juveniles were successfully grown at salinities ranging from 32 - 34 ppt in the laboratory. Adults are usually found at full salinities but were successfully kept in the laboratory at 22 ppt for several weeks (Cargnelli *et al.,* 1999a). However, no information on the effects of hypersaline conditions was found.

Salinity changes - local decrease	Larval *Arctica islandica* were collected at mean salinities of 32.4 ppt in the USA, while juveniles were successfully grown at salinities ranging from 32 - 34 ppt in the laboratory. Adults are usually found at full salinities but were successfully kept in the laboratory at 22 ppt for several weeks (Cargnelli *et al.,* 1999a). *Arctica islandica* was also recorded in the Baltic at salinities ranging from 20-26 psu. It is likely that *Arctica islandica* could withstand a long-term decrease in salinity at the benchmark level e.g. from full to reduced salinity. An acute change, e.g. from full to low salinity for one week could potentially have adverse effects, however, *Arctica islandica* can bury itself, and remain inactive for up to 10 days (Taylor, 1976), and could avoid the change in salinity. Therefore, tolerant has been recorded at the benchmark level, although further decreases in salinity over longer periods of time would cause mortalities.
Water flow (tidal current) changes - local increase	Adults buried at depth are likely to be unaffected. Larvae and juveniles however, may be damaged or prevented from settling which could affect recruitment levels into the population. An increase in water flow may increase the availability of food in the water column and remove any waste present. As a result intolerance is assessed as low with very high recoverability.
Water flow (tidal current) changes - local decrease	A decrease in water flow could result in a reduction in food that may be obtained from suspension feeding. Therefore *Arctica islandica* would have to switch to deposit feeding. Intolerance is assessed as low with very high recoverability.
Emergence regime changes - local increase	During periods of increased emergence individuals will not be able to feed and respiration may also be compromised. Thermal stress may occur and the risk of predation is increased. Over the benchmark period of 1 year it is expected that individuals in the sublittoral fringe or shallow infralittoral may be at risk and may lead to some mortality. Therefore, intolerance is assessed as intermediate with a moderate recoverability. See additional information below for recoverability information.
Emergence regime changes - local decrease	The larvae of *Arctica islandica* can be found at depths of 1 m, a decrease in emergence could allow the species to colonize further up the shore. Periods of thermal stress, desiccation and predation would be reduced. Dislodgement of individuals may also be reduced. A decrease in emergence may benefit this species therefore intolerance is assessed as tolerant, and recoverability as not relevant.
Wave exposure changes - local increase	Strong wave action may cause changes in the substrata that *Arctica islandica* in habits. Coarse sediments will tend to become unstable and difficult to burrow, which could cause displacement but, will lack the fine particles which tend to clog gills and filtering mechanisms (Earll & Erwin, 1983). Increased wave exposure could also damage or cause the withdrawal of the siphons, which reduces their ability to feed and growth could be compromised. Increased wave exposure may also be detrimental to predators of *Arctica islandica* and prevent them from feeding. More powerful waves may also cause injuries to the shell of *Arctica islandica* and may cause energy for growth to be diverted for repairs. The dispersion and settlement of larval and juvenile stages may also be disrupted. *Arctica islandica* is found throughout the British isles in areas ranging from fairly to very exposed wave action. Therefore, intolerance has been assessed as intermediate with high recoverability.

Wave exposure changes - local decrease	Changes in wave exposure are likely to have marked effects on the sediment dynamics. Low exposure could increase siltation and the risk of smothering. *Arctica islandica* lives infaunally below depths of 30 m. Its habitat varies from sand and muddy sand that ranges from fine to coarse grains therefore such a change in the substrata is unlikely to have major effects on the species. Therefore intolerance has been assessed as tolerant and recoverability has been assessed as not relevant.
Water clarity increase	*Arctica islandica* does not require light therefore the effects of decreased turbidity on light attenuation are not directly relevant. It is possible that a decrease in turbidity could increase primary production in the water column, which could increase food availability. Therefore, this factor was not considered to be relevant.
Water clarity decrease	*Arctica islandica* does not require light therefore the effects of increased turbidity on light attenuation are not directly relevant. An increase in turbidity may affect primary production in the water column that would lower phytoplankton availability. However, *Arctica islandica* can also feed on surface deposits. Therefore, this factor was not considered to be relevant.
De-oxygenation	Under unfavourable conditions, bivalves are able to reduce contact with the ambient medium by closing their shells and reduce any mechanical activity, which in turn reduces the demand for oxygen required. *Arctica islandica* were reported to be resistant to severe hypoxia (Theede *et al.*, 1969, Diaz & Rosenberg, 1995). Kiel Bay (Baltic Sea) has seen significant declining trends in deep water oxygen concentration since the 1950's. In 1981 the salinity was 20 - 26 psu, and temperatures of 10-14°C were recorded. Anoxia and hydrogen sulphide were widespread below the halocline at a depth of >20 m (Rosenberg & Loo, 1988). The anoxic event lasted several weeks and during that time, 30,000t of macrofauna died over 750 km^2. However, *Arctica islandica* was amongst the few surviving species. Another area that has recorded severe hypoxic events was in the Kattegat (Sweden). The worst year recorded was 1988, when approximately 30,000 km^2 of the bottom water was hypoxic. Oxygen concentrations recorded were 3.1 ml/l in June, 1.0 ml/l in August, and 0.9 ml/l in September, and *Arctica islandica* was amongst the surviving species. However, in an anoxic episode off New Jersey (USA), up to 13.3% of the *Arctica islandica* population died in shallow waters, while in deeper water the population was not affected (Ropes *et al.*, 1979; Cargnelli *et al.*, 1999a). *Arctica islandica* can respire anaerobically for up to seven days (Tayler, 1976; Cargneli *et al.*, 1999a). Ropes *et al.* (1979) reported a critical oxygen tension for *Arctica islandica* of 5-7 kPa (2.2-3.1 mg/l). The tolerance of *Arctica islandica* to hypoxia and hydrogen sulphide was investigated by Theede (1973). The LT50 (50% mortality) occurred in *Arctica islandica* around 75 days into the experiment at an oxygen concentration of <0.15 ml/l (at 10 °C and pH 8.2 - 8.45) and the LT50 occurred after around 66 days with the addition of hydrogen sulphide (Theede, 1973). Environmental factors such as temperature can effect a species resistance to hypoxic conditions. With decreasing temperature below 10°C the cellular resistance of *Arctica islandica* increases more than in species such as *Mytilus edulis* (Theede, 1973). *Arctica islandica* has shown tolerance to severe decreases in oxygenation, therefore intolerance has been assessed as low at the benchmark level, indicating that some stress is likely with an immediate recoverability as respiration rates should return to normal within 20 hours, on returning to normal conditions.

Nutrient enrichment	No specific information regarding the effects of nutrients on *Arctica islandica* were found. Increased nutrients are likely to enhance algal and phytoplankton growth, increase organic material deposits and enhance bacterial growth. Increased phytoplankton levels will enhance the level of food that is available. However, increased levels of nutrients may also result in eutrophication, algal blooms and a reduction in oxygen concentrations. There is also a risk of clogging the feeding structures. In a study off the west coast of Kattegat (Sweden), Rosenberg & Loo (1988) reported mass moralities of the bivalves *Mya arenaria* and *Cerastoderma edule* following a eutrophication event but, no direct causal link was established. However, the abundance of *Arctica islandica* remained very high despite falls in other bivalve populations. Therefore, an increase in nutrient levels is unlikely to cause mortality in *Arctica islandica* and an intolerance of low has been recorded.
Habitat structure changes - removal of substratum (extraction)	*Arctica islandica* lives infaunally in muddy/sandy sediments. Removal of the substratum would also remove the entire population of this species and so the intolerance has been assessed to be high with a low recoverability rate. See additional information below for recoverability information.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	*Arctica islandica* has a thick, solid and heavy shell but despite this is known to be vulnerable to physical abrasion. The damage to this species was related to their body size, larger specimens were more affected than smaller ones (Klein & Witbaard, 1993). As a result of dredging in the southeast North Sea, only 10% of empty shells collected were undamaged (Klein & Witbaard, 1993). Klein & Witbaard (1993) noted that 90% of shell scars were found on the posterior side. Up to 90% of *Arctica islandica* caught by a commercial trawler were severely damaged with an estimated mortality rate ranging from 74% - 90% (Fronds, 1991; cited in Klein & Witbaard, 1993). It must be noted that shells were also damaged on board as well as during the fishing process. The number of damaged shells and the number caught increased when tickler chains were used. For example 74% were damaged with the use of tickler chains whereas only 27% were damaged without their use. In the Baltic Sea, the annual disturbance of the fishing area by otter boards was estimated to be 20 % (Rumohr & Krost, 1991). Specimens exposed on the sediment surface would be at risk of predation. Therefore, intolerance is assessed as intermediate at the benchmark level with a high recoverability level.
Siltation rate changes	*Arctica islandica* is a burrower in muddy/sandy sediments. It uses its short inhalant siphon above the sediment surface for feeding and respiration (Taylor, 1976). Sudden smothering of the sediment would halt feeding. As a burrower *Arctica islandica* is able to switch from aerobic to anaerobic respiration and are generally considered to be tolerant of anoxia (Theede *et al.,* 1969, Rosenberg & Loo, 1988). However, high mortality of a Baltic population was recorded following an anoxic event (see oxygenation below). Therefore an intermediate intolerance level has been given, with moderate recoverability. For recoverability see additional information below.
	Levels of suspended sediment are likely to be most relevant to feeding. An increase in suspended sediment is likely to increase the rate of siltation and the availability of food. *Arctica islandica*, would probably switch to deposit feeding as a result. Therefore tolerant has been recorded.

	Levels of suspended sediment are likely to be most relevant to feeding. A decrease in suspended sediment is likely to decrease the availability of food for both suspension and deposit feeding bivalves. Mortality is unlikely to occur within 1 month (see benchmark) and so intolerance is assessed as low. When suspended sediment levels return to normal, so too should food availability and feeding.
Removal of target species	*Arctica islandica* is commercially harvested in the United States and Iceland. The principle gear used to fish *Arctica islandica* off the northwest coast of America is the hydraulic clam dredge. Between 1976 and 1979 landings of *Arctica islandica* increased from 2,5000 to 15,800 mt of meats per year and has increased further to 17,900 mt in 1984. Recent quota reductions have seen a decline to 14,900 mt. Although current annual landings are only 2 % of the total estimated stock, Weinberg (2001) suggested that greater landings would be unsustainable and that recovery time would be extremely long. Trends in fishery performance using catch and effort data in the mid-Atlantic have shown a decline in landings of *Arctica islandica* since 1991 (Weinberg, 2001). Therefore, intolerance has been assessed as intermediate with a moderate recoverability level.
Removal of non-target species	In the North Sea *Arctica islandica* were recorded as by-catch in a 12 m beam trawl catch, which suggested that the use of tickler chains had penetrated hard sandy substrata to a depth of at least 6 cm (Klein & Witbaard, 1993). It was estimated that up to 90% of the *Arctica islandica* in the catch had broken shells, however no information was provided on the number that were damaged and had remained in the sediment. It was argued that predators such as the cod, had caused shell damage. But cod are not able to crush *Arctica* shells larger than 4 cm and the prevalence of *Arctica islandica* in the stomach contents of cod coincided with times of intensive otter trawling (Klein & Witbaard, 1993). In Kiel Bay, Rumohr & Krost (1991) recorded larger numbers of *Arctica islandica* in a dredge towed directly behind an otter board than in the centre of the net. Divers have also observed damaged specimens of *Arctica islandica* while surveying areas of the seabed that have been disturbed by beam trawls (reference). Also the catch efficiency of commercial trawls for species such as *Arctica islandica* is low; therefore the overall mortality is very low when expressed as a percentage of the initial density of the species (Craymeersch *et al.,* 2000). Although *Arctica islandica* are vulnerable to damage by trawls, those that are slightly damaged can repair cracks in their shell matrix. An intolerance assessment of intermediate is given as some individuals will be damaged and some mortality will occur. As the rate of shell damage is related to body size, with larger specimens being more affected than smaller specimens a recoverability assessment of moderate is given as larger adults are more likely to be affected.

3.5	***Armandia cirrhosa***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Salinity changes - local	The species has only been recorded at sites with reduced salinity so can therefore probably not tolerate fully marine conditions.
Water flow (tidal current) changes - local	Increased water flow may wash away the worm and associated fine sediment. Recovery would be very low because only two extant populations of the spices exist within the UK.
Emergence regime changes - local	The low shore position of the species suggests that it is intolerant of emergence. However, if it lives in a mud burrow it would be sheltered from desiccation and temperature extremes. Insufficient information is available to be able to make an accurate assessment.
Wave exposure changes - local	The species is within the top 1 cm of the sediment so would be removed upon increased wave exposure. The fine sediment with which the worm is usually associated would also be washed away. Tamaki (1987) observed that an unidentified species of *Armandia* in Japan was very susceptible to increased wave exposure because it is in the top 1 cm of the sediment.
Water clarity changes	The species is probably tolerant of a change in turbidity as it is not affected by light availability.
Habitat structure changes - removal of substratum (extraction)	*Armandia cirrhosa* is probably found within the top 1-2 cm of sediment so would be removed upon substratum loss. Recovery would be very low because only two extant populations of the species exist within the UK.
Heavy abrasion, primarily at the seabed surface	*Armandia cirrhosa* lives in the top 1-2 cm of the sediment which would be disturbed by physical disturbance caused by a passing scallop dredge or equivalent disturbance. Individuals in direct contact with the disturbance causing impact are likely to be damaged and/or killed, however, *Armandia cirrhosa* is very small so that a proportion of the population is likely to be missed or displaced. Therefore, an intolerance of intermediate has been recorded.
Light abrasion at the surface only	
Siltation rate changes	The species is probably tolerate to siltation as it occurs in lagoons where siltation naturally occurs.
	The species would be able to move through new sediment and re-establish itself upon smothering.

3.6	***Eunicella verrucosa***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	*Eunicella verrucosa* extends from south-west Britain to the Mediterranean (Manual, 1988). Therefore, it is a warmer water species and will most likely grow faster and reproduce more frequently in warmer conditions. In the case off an acute rise in temperature at the warmest time of year, it is not expected that temperature will be harmful.
Temperature changes - local decrease	Long-term decrease in temperature is likely to lead to a poor year for recruitment but is unlikely to lead to mortality. A live specimen collected from shallow depths off North Devon in 1973 exhibited growth rings that demonstrated that the colony had survived the 1962/63 cold winter. Also, large colonies were being collected from Lundy in the late 1960's suggesting no significant loss in 1962/63. (K. Hiscock, own observations.) Assuming that temperature decrease reduces recruitment, the population size might decline for a year but recovery will occur following a successful recruitment.
Salinity changes - local increase	Sea fans live in fully saline conditions in the open sea. Increase in salinity may only occur marginally to levels more typical of the Mediterranean where sea fans thrive.
Water flow (tidal current) changes - local increase	Sea fans are found in strong tidal streams but most likely retract their polyps when current velocity gets too high for the polyps to retain food. Tidal streams exert a steady pull on the colonies and are therefore likely to detach only very weakly attached colonies. 'Moderate' recoverability reflects the infrequency of recruitment and slow growth rate for replacement colonies to reach a significant size.
Water flow (tidal current) changes - local decrease	Colonies rely on high water flow rates to bring food and to remove silt. Colonies deprived of food may be adversely affected and, without significant water flow to remove silt, silt may kill tissue leaving areas bare of coenenchyme to be colonized by encrusting organisms. 'Moderate' recoverability reflects the infrequency of recruitment and slow growth rate for replacement colonies to reach a significant size.
Emergence regime changes - local increase	Sea fans are found only in the circalittoral and so changes in emergence are not relevant.
Emergence regime changes - local decrease	Sea fans are found only in the circalittoral and so changes in emergence are not relevant.
Wave exposure changes - local increase	Sea fans will be detached from the substratum by storms. Detached colonies are frequently seen on the seabed and after severe storms may be washed-up on the strandline. Not all colonies are likely to be killed and, whilst density of colonies might be back to pre-event levels within a few years, recovery to a population structure similar to before mortality is likely to be in excess of five years.
Wave exposure changes - local decrease	Sea fans live in conditions where either wave action or tidal flow bring food and keep colonies clear of silt. If tidal streams are weak, then wave action may be important and a decrease in wave exposure may result in some mortality. Not all colonies are likely to be killed and recovery to a population structure similar to before mortality is likely to be a few years.

Water clarity increase	Whilst *Eunicella verrucosa* most likely relies on plankton rather than suspended organic matter for food, decreases in turbidity can have a significant adverse impact on shallow water populations because of increased amounts of summer ephemeral seaweeds growing and smothering colonies. Not all colonies are likely to be killed and recovery to a population structure similar to before mortality is likely to be a few years. However, because of sporadic recruitment, it may take more than five years for the population structure to regain a similar size.
Water clarity decrease	*Eunicella verrucosa* occurs in the turbid waters of North Devon and, in its usual locations in clearer water. It seems, therefore, that it will survive short-term increases in turbidity. Increased turbidity will also lead to a reduction in the abundance of algae which can smother sea fans.
Nutrient enrichment	It is not expected that a change in nutrients will have a significant effect on *Eunicella verrucosa* abundance and survival. Sea fans feed on planktonic organisms and, although abundance of those organisms might change as nutrient concentrations vary, the long term effects on food sources are not likely to be significant. However, algae colonize and may smother sea fans and may increase in abundance as a result of increase in nutrient concentrations.
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	Physical disturbance and abrasion is likely to damage the coenenchyme, although sea fans are firmly attached and very flexible so are unlikely to be detached unless 'hooked' by the abrasive object. The report by Eno *et al.* (1996) suggested that *Eunicella verrucosa* was "remarkably resilient" to impact from lobster pots. However, abrasion that removes the coenenchyme may allow the settlement of epibiota that will increase drag and may include species that bore into the skeleton and weaken the colony (impacts observed on the structurally similar sea fan *Paramuricea clavata* described by Bavestrello *et al.*, 1997). Since some individuals in a population may be killed or viability reduced, intolerance is recorded as intermediate. The coenenchyme covering the axial skeleton will re-grow over scrapes of one side of the skeleton in about one week (Keith Hiscock, pers comm.). However, where whole individuals are killed recoverability is likely to be low as many individual colonies will be 20 or more years old and recruitment is likely to be sporadic.
Siltation rate changes	Colonies of *Eunicella verrucosa* extend above the substratum and therefore above the smothering. Some small individuals might be killed but the majority of individuals will survive. Settlement appears to be sporadic and may not occur for several years. However, since only small colonies would be expected to be killed and, with large colonies nearby, they will be replaced, recoverability is moderate.
	Colonies produce mucus to clear themselves of silt and therefore, although siltation might occur and inhibit feeding for a while, the silt will be removed by water movement or mucus.
	Sea fans thrive in clear water conditions and, since silt is unlikely to be used as part of the diet, a decrease in siltation is believed to be not relevant.
Introduction or spread of non-indigenous species	No non-native species are known to be associated with or adversely affect *Eunicella verrucosa*.
Introduction of microbial pathogens	Insufficient information.

Removal of target species	Extraction for the souvenir trade occurred in localised areas in the late 1960's. Large colonies were selected and so some of the population remained to grow and reproduce locally. Recovery of populations would be likely to be more rapid than if all had been removed. However, although settlement of replacement individuals might occur rapidly, colonies grow slowly and the establishment of populations with large individuals will take many years.
Removal of non-target species	Species associated with *Eunicella verrucosa* are not extracted and the populations occur on rock where destructive activities such as dredging and trawling are unlikely to occur.

3.7	***Gammarus insensibilis***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local	The species inhabits lagoons which are naturally subject to wide variations in temperature. Therefore the species can probably tolerate a wide temperature range.
Salinity changes - local	The species is found in hyper and hyposaline waters in the UK and fully saline conditions in the Mediterranean. The species is probably able to tolerate a wide range of salinities, but the length of time for which the species could tolerate freshwater is unknown. The species has been lost from Widewater, West Sussex, where a reduction in sea-water input has resulted in hypersaline conditions during the summer months. Within the Keyhaven-Lymington lagoon system, *Gammarus insensibilis* has been lost from the western Keyhaven-Pennington section, following sea-wall reconstruction which resulted in markedly hyposaline conditions, especially in winter (M. Sheader, pers. comm.).
Water flow (tidal current) changes - local	*Gammarus insensibilis* lives in lagoons where there is low water flow. An increase in water flow rate could cause the species to be washed away.
Emergence regime changes - local	The species would be affected by desiccation during emersion. The algae on which it feeds may also dry out. Recovery would be low due to the species limited distribution.
Wave exposure changes - local	The species naturally occurs in very sheltered locations and could be washed away if the wave exposure increased. The algae on which it feeds could also be detached, so removing its food source. Recovery would be low due to the species limited distribution.
Water clarity changes	*Gammarus insensibilis* feeds on the alga *Chaetomorpha* which is dependant on light availability for photosynthesis. Turbidity would reduce light availability and therefore probably the abundance of *Chaetomorpha*.
Habitat structure changes - removal of substratum (extraction)	The species would be removed upon substratum loss and recovery would be low due to the species limited distribution. Removal of the algal mats with which *Gammarus insensibilis* is associated would remove the amphipods food source.
Heavy abrasion, primarily at the seabed surface	*Gammarus insensibilis* lives amongst algae and the species is not very flexible so it could be damaged by an object landing on, or being dragged across, the sea bed. However, many individuals would be displaced but survive or may be 'cushioned' by surrounding sediment. Therefore, intolerance has been assessed as intermediate. Recovery may be prolonged and moderate due to the species limited distribution.
Light abrasion at the surface only	
Siltation rate changes	The species would probably be able to move up through new sediment and therefore tolerate smothering. However, smothering may cause the removal of the species algal food source.

	Gammarus insensibilis is probably tolerant of siltation because it lives in lagoons where siltation naturally occurs. High levels of siltation may reduce light availability and therefore probably the abundance of the species food source *Chaetomorpha linum*.

3.8	***Gobius cobitis***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Temperature and oxygen levels change drastically over a tidal cycle in a rockpool. Berschick et al. (1987) and Trouchot & Duhamel-Jouve (1980) stated that *Gobius cobitis* is well-adapted to the short term oxygen and temperature changes which occur on a daily basis within intertidal rockpools. The geographical distribution of *Gobius cobitis* extends from the south western tip of Britain to waters further south. *Gobius cobitis* populations in southern waters are therefore exposed to warmer waters. Long term increases in temperature due to climate warming would therefore be likely to increase the population size. Furthermore, it has been shown that temperature does have an effect on the speed of larval development (the greater the temperature the shorter the development time needed) (Gil et al., 1997) and the time of the breeding season. Horn & Gibson (1990) also showed that food consumption increased and gut transition times decreased. On balance, *Gobius cobitis* is expected to be tolerant of an increase in temperature at the benchmark level.
Temperature changes - local decrease	A temperature decrease is not likely to have a significant impact on *Gobius cobitis* in its southern range. However, during the severe winter period in 1962-63 the south-west coast of Britain experienced temperatures 5 and 6ºC below the long-term average for about 2 months. During this period there was heavy mortality of observed populations of *Gobius paganellus*, *Gobius minutus* and *Gobius flavens* (Crisp (ed.), 1964). Therefore a decrease in temperature may affect populations in the British Isles, by either shifting the geographical distribution further southwards towards warmer waters, or killing a proportion of the northern-most population. A decrease in temperature is likely to cause a proportion of the population to die and is therefore recorded as intermediate. Recoverability is likely to be high (see Additional Information section below).
Salinity changes - local increase	*Gobius cobitis* must be able to tolerate variable salinities due to differences in freshwater run-off or variations in rain-fall in their intertidal environment. It is, therefore, unlikely to be affected by a short or long term change in salinity. A low intolerance has been recorded, and recoverability is likely to be high (see Additional Information section below).
Salinity changes - local decrease	*Gobius cobitis* must be able to tolerate variable salinities due to differences in freshwater run-off or variations in rain-fall in their intertidal environment. It is, therefore, unlikely to be affected by a short or long term change in salinity. A low intolerance has been recorded, and recoverability is likely to be high (see Additional Information section below).
Water flow (tidal current) changes - local increase	The ability of *Gobius cobitis* to shelter in crevices between large boulders would be able to shield them from a moderate increase in the water flow rate. However, it is unlikely that they could withstand a large increase in water flow rate, as this would decrease the giant goby's ability to forage. Therefore, a low intolerance to water flow rate has been recorded. Recoverability is likely to be very high.
Water flow (tidal current) changes - local decrease	*Gobius cobitis is likely to be tolerant of a decrease in water flow rate.*

Emergence regime changes - local increase	It is unlikely that *Gobius cobitis* would be affected by a change in the emergence regime as at high tide it forages over the shore and at low tide it inhabits rock pools.
Emergence regime changes - local decrease	It is unlikely that *Gobius cobitis* would be affected by a change in the emergence regime as at high tide it forages over the shore and at low tide it inhabits rock pools.
Wave exposure changes - local increase	Faria & Almada (1999) found that when fish were removed or added to pools which had been disturbed by storms (which move large quantities of sand and reshape their contents) the observed negative effects on the population are variable. However, storms are an extreme event and the giant goby is sufficiently mobile and able to shelter in rock crevices. Therefore, a change of two ranks on the wave exposure scale is unlikely to affect the giant goby.
Wave exposure changes - local decrease	A reduction of two ranks on the wave exposure scale is unlikely to affect the giant goby.
Water clarity increase	Decreases in turbidity benefit algal growth and therefore more food (algae and associated crustaceans) would be readily available. This would be beneficial to the population and tolerant* has been suggested.
Water clarity decrease	An increase in turbidity would result in a reduction in the amount of light penetration and, subsequently, a decrease in algal growth. Algae is the preferred food source of *Gobius cobitis*, but other food sources (such as Crustacea and Polychaeta) would still be readily available. The minimum light intensity needed for the detection and recognition of food are of great importance in many species of fish (Kinne, 1970). For instance if the organism needs to spend more time foraging for food, its energy expenditure will increase and could possibly lead to growth and reproductive problems. In heavily turbid waters fish larvae have been noted to show a greater than normal mortality. It is probable that *Gobius cobitis* would be intolerant of changes in turbidity on a large scale, but probably not with changes of approximately 50 mg/l over a month. Therefore, a low intolerance to turbidity has been recorded. Recoverability is likely to be high (see Additional Information section below).
Habitat structure changes - removal of substratum (extraction)	*Gobius cobitis* lives and forages on a variety of substrata. It requires rockpools in the intertidal to survive at low tide. Therefore, loss of rockpools (for instance, by infilling) or loss of rocky substrata (for instance, by spoil dumping or land claim) will most likely cause a proportion of the species population to die. However, at high tide adults are sufficiently mobile and will be able to recolonize areas which contain suitable substrata. Intolerance due to substratum loss is assessed as intermediate. Recoverability is likely to be high (see Additional Information section below).
Heavy abrasion, primarily at the seabed surface	*Gobius cobitis* is sufficiently mobile to avoid abrasive contact and to shelter from it, therefore it is unlikely to suffer from abrasion.
Light abrasion at the surface	

only	
Siltation rate changes	*Gobius cobitis* will not be affected by smothering as they are mobile and able to swim away. However, destruction of habitat is important. Cordone & Kelley (1961) reported that (in a freshwater habitat) deposition of sediment on the bottom of the substratum would destroy needed shelter, reduce the availability of food, impair growth and lower the survival rate of eggs and larvae of fish. It is likely that *Gobius cobitis* would be more intolerant if smothering occurred during the breeding season due to the probable destruction of broods of eggs. Materials such as concrete, oil or tar are likely to have a greater negative impact on the population. Intolerance due to smothering is assessed as intermediate. Recoverability is likely to be high (see Additional Information section below).
	Moore (1977) indicated that an increase in siltation can have a negative effect on the growth of adult fish, survival of eggs and larvae and pathological effects on gill epithelia. Bottom-dwelling species are generally found to be tolerant of suspended solids (Moore, 1977). Juveniles have been reported as being more intolerant of siltation than adults (Moore, 1977). Therefore, a low intolerance to siltation has been recorded. Recoverability is likely to be high (see Additional Information section below).
	Gobius cobitis is likely to be tolerant of a decrease in suspended sediment.
Introduction or spread of non-indigenous species	No alien or non-native species are known to affect *Gobius cobitis* in Britain and Ireland.
Removal of target species	*Gobius cobitis* have been found at local Mediterranean fish markets (Miller, 1986). However, if larger amounts of the population were extracted, the population density will decline at first. Therefore, the species has been assessed as intermediate. However, recoverability is likely to be high (see Additional Information section below).
Removal of non-target species	*Gobius cobitis* is not known to depend on any other species. Therefore, it is likely to be not sensitive to the extraction of other species.

3.9	***Gobius couchi***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Insufficient information was available to assess the sensitivity of *Gobius couchi* to an increase in temperature.
Temperature changes - local decrease	Temperature and oxygen levels change drastically over a tidal cycle in a rockpool. Couch's goby is capable of tolerating temperatures less than 6ºC by falling in to a torpid state underneath stones (Minchin, 1988). By falling into this torpid state its ability to forage for food and reproduce is reduced. The geographical distribution of *Gobius couchi* is restricted to the south-west of England and the Mediterranean Sea. A temperature decrease is likely to have an impact on *Gobius couchi* . During the severe winter period in 1962-63 the south-west coast of Britain experienced temperatures 5 and 6 ºC below the long-term average for about 2 months. During this period there was heavy mortality of observed populations of *Gobius paganellus*, *Gobius minutus*, and *Gobius flavens* (Crisp (ed.), 1964). Therefore a decrease in temperature may affect populations in the British Isles, by either shifting the geographical distribution further southwards towards warmer waters, or killing a proportion of the northern-most population. Intolerance has been assessed as intermediate. Recoverability is likely to be high (see Additional Information section below).
Salinity changes - local increase	No information is available for salinity effects on Couch's goby. However they do inhabit a wide range of habitats, with varying salinities. This implies that they are able to adapt reasonably well to various salinities.
Salinity changes - local decrease	No information is available for salinity effects on Couch's goby. However they do inhabit a wide range of habitats, with varying salinities. This implies that they are able to adapt reasonably well to various salinities.
Water flow (tidal current) changes - local increase	The ability of *Gobius couchi* to shelter in crevices between large boulders would be able to shield them from a moderate increase in the water flow rate. However, it is unlikely that they could withstand a large increase in water flow rate, as this would decrease the goby's ability to forage. Intolerance is assessed as low. Recoverability is likely to be high (see Additional Information section below).
Water flow (tidal current) changes - local decrease	*Gobius couchi* is likely to be tolerant of a decrease in water flow rate.
Emergence regime changes - local increase	It is unlikely that *Gobius couchi* would be affected by a change in the emergence regime as at high tide it forages near the shore and at low tide it inhabits rock pools.
Emergence regime changes - local decrease	It is unlikely that *Gobius couchi* would be affected by a change in the emergence regime as at high tide it forages near the shore and at low tide it inhabits rock pools.

Wave exposure changes - local increase	Faria & Almada (1999) found that when rocky intertidal fish were removed or added to pools which had been disturbed by storms (which move large quantities of sand and reshape their contents) the negative effects on populations were variable. However, storms are an extreme event and couch's goby is sufficiently mobile and able to shelter in rock crevices or move to deeper water. Therefore, a change of two ranks on the wave exposure scale is unlikely to affect the goby.
Wave exposure changes - local decrease	A reduction of two ranks on the wave exposure scale is unlikely to affect the goby.
Water clarity increase	Decreases in turbidity benefit algal growth and therefore more food (algae and associated crustaceans) would be readily available. This would be beneficial to the population and tolerant* has been suggested.
Water clarity decrease	An increase in turbidity would lead to a reduction in the amount of light penetration and, subsequently, a decrease in algal growth. Algae is the preferred food source of *Gobius couchi*, but other food sources (such as crustaceans and polychaetes) would still be readily available. The minimum light intensity needed for the detection and recognition of food are of great importance in many species of fish (Kinne, 1970). For instance if the organism needs to spend more time foraging for food, its energy expenditure will increase and could possibly lead to growth and reproductive problems. In heavily turbid waters fish larvae have been noted to show a greater than normal mortality. It is probable that *Gobius couchi* would be intolerant of changes in turbidity on a large scale, but probably not with changes of approximately 50 mg/l over a month. Therefore the species intolerance to turbidity is recorded as low. Recoverability is likely to be high (see Additional Information section below).
Nutrient enrichment	Higher nutrient levels may encourage the growth of algae such as *Ulva spp.*, which is an important food source for *Gobius couchi*. In comparison, a decrease in nutrient levels may lead to a decrease in the availability of green algae. However, this is likely to exert a slight effect on the couch's goby as it is able to ingest other types of food (such as crustaceans and polychaetes). Therefore, a low intolerance to nutrients has been recorded. Recoverability is likely to be high (see Additional Information section below).
Habitat structure changes - removal of substratum (extraction)	*Gobius couchi* lives and forages on a variety of substrata. It requires rockpools in the intertidal to survive at low tide. Therefore, loss of rockpools (for instance, by infilling) or rocky substrata (for instance, by spoil dumping or land claim) will most likely cause a proportion of the species population to die. However, at high tide adults are sufficiently mobile and will be able to recolonize areas which contain suitable substrata. Intolerance to substratum loss is assessed as intermediate. Recoverability is likely to be high (see Additional Information section below).
Heavy abrasion, primarily at the seabed surface	*Gobius couchi* is sufficiently mobile to avoid abrasive contact and to shelter from it, therefore it is unlikely to suffer from abrasion.
Light abrasion at the surface only	

Siltation rate changes	*Gobius couchi* will not be affected by smothering as they are mobile and able to swim away. However, destruction of habitat is important. Cordone & Kelley (1961) reported that (in a freshwater habitat) deposition of sediment on the bottom of the substratum would destroy needed shelter, reduce the availability of food, impair growth and lower the survival rate of eggs and larvae of fish. It is likely that *Gobius couchi* would be more intolerant if smothering occurred during the breeding season due to the probable destruction of broods of eggs. Materials such as concrete, oil or tar are likely to have a greater negative impact on the population. Intolerance due to smothering is assessed as intermediate. Recoverability is likely to be high (see Additional Information section below).
	Moore (1977) indicated that an increase in siltation can have a negative effect on the growth of adult fish, survival of eggs and larvae and pathological effects on gill epithelia. Bottom-dwelling species are generally found to be tolerant of suspended solids (Moore, 1977). Juveniles have been reported as being more intolerant of siltation than adults (Moore, 1977). Therefore, intolerance has been recorded as low. Recoverability is likely to be high (see Additional Information section below).
	Gobius couchi is likely to be tolerant of a decrease in suspended sediment.
Removal of target species	*Gobius couchi* has a restricted distribution, and is a rare and protected species. Therefore extraction of this species would have a great impact on the population density and viability. Intolerance is recorded as high, and recoverability is recorded as moderate (see Additional Information section below).
Removal of non-target species	*Gobius couchi* is not known to depend on any other species. Therefore, it is likely to be not sensitive to the extraction of other species.

3.11	*Hippocampus hippocampus*
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	No specific information was found on the effects of temperature on *Hippocampus hippocampus*, although temperature is known to affect reproduction rates. *Hippocampus hippocampus* is a predominantly southern species in British waters. It is also found in the Mediterranean, the Black Sea, and round the African coast to the Gulf of Guinea. *Hippocampus hippocampus* has been recorded in temperatures between 18 to 25 ºC (Fishbase, 2000) and as low as 5 or 6 ºC in the winter in British waters (N. Garrick-Maidment, pers. comm.). An increase in temperature may affect spawning levels. In captivity, *Hippocampus hippocampus* can be adapted to tropical temperatures. This was done by raising the water temperature very slowly over a period of time so that the seahorses are able to adapt with no adverse affects. Therefore an increase in temperature at the benchmark level may increase the viability of the population in British waters. *Hippocampus hippocampus* would therefore be tolerant* of this factor.
Temperature changes - local decrease	No specific information could be found on the effect of a decrease in temperature on *Hippocampus hippocampus. Hippocampus hippocampus* predominantly occurs in the southern waters of the British Isles. However, there have been reports of *Hippocampus hippocampus* in water temperatures as low as 5-6 ºC (Garrick-Maidment, pers. comm., February 2004). Therefore *Hippocampus hippocampus* is likely to be tolerant of a decrease in temperature at the benchmark level. However, reproductive output is likely to be reduced and adults may migrate away from an area that has cooled, therefore intolerance has been assessed as intermediate with a moderate recovery.
Salinity changes - local increase	No information could be found on the effects of increased salinity on *Hippocampus hippocampus.*
Salinity changes - local decrease	The gill structure of *Hippocampus hippocampus* allows them to cope with brackish waters, showing a tolerance for a slight decrease in salinity (Garrick-Maidment, pers. comm., February 2004) but no information could be found on the effects of decreased salinity on *Hippocampus hippocampus*.
Water flow (tidal current) changes - local increase	Water flow is vital in aiding the distribution of seahorse fry (N. Garrick-Maidment, pers. comm.). However, an increase in water flow associated with storms could have a detrimental affect, such as carrying adults and young fry away from their home range, or separating a bonded pair, but not in normal circumstances. The benchmark suggests an increase in flow rate of two categories which could see the seahorses experiencing flow rates of 6 knots therefore, intolerance has been assessed as intermediate with a moderate recoverability.
Water flow (tidal current) changes - local decrease	*Hippocampus hippocampus* inhabit sheltered areas. A decrease in water flow would reduce the risk of young fry or one individual from a bonded pair being carried away to another home range. *Hippocampus hippocampus* are active ambush feeders, therefore are not reliant on water flow for food availability. Therefore a further decrease in the water flow rate at the benchmark level is unlikely to affect this species and tolerant has been recorded.

Emergence regime changes - local increase	*Hippocampus hippocampus* generally occurs below 5 m and is unlikely to be affected by increases in emergence. Any periods of emergence of the habitat in which *Hippocampus hippocampus* occurs are, therefore, likely to be brief and the wetness of the algae and the seagrass would protect the seahorses. *Hippocampus hippocampus* is mobile and may be able to recolonize in deeper water. Some stress may occur, therefore, intolerance has been assessed as low with a very high recoverability.
Emergence regime changes - local decrease	As a predominantly sublittoral species, a decrease in emergence may benefit populations of *Hippocampus hippocampus* found on the lower shore by providing additional substratum for colonization. Therefore tolerant* has been recorded.
Wave exposure changes - local increase	Increased wave exposure may carry young fry away from their home range or disrupt a bonded pair. However *Hippocampus hippocampus* are mobile and use seagrasses and algae as holdfasts. *Hippocampus hippocampus* has been known to move out into deeper waters over winter. It has been suggested that this occurs in order for the seahorses to avoid storms and their effects (Garrick-Maidment, 1998).Increased wave exposure may also be effect the substratum, reducing the extent of sea grass present . Seagrasses are vulnerable to damage cause by increased wave exposure, which could reduce the available habitat for *Hippocampus hippocampus* (see IMS.Zmar for further information). *Hippocampus hippocampus* is found in sheltered areas with gentle currents. Therefore, it is likely that they would be intolerant of an increase in wave exposure at the benchmark level. Hence, intolerance has been assessed as intermediate with a moderate recoverability.
Wave exposure changes - local decrease	*Hippocampus hippocampus* and the seagrass beds that they inhabit are found in sheltered areas. Therefore, a decrease in wave exposure at the benchmark level is unlikely to affect *Hippocampus hippocampus* and this factor has been considered not relevant.
Water clarity increase	Decreases in turbidity may benefit algal growth and therefore increase the preferred habitat of *Hippocampus hippocampus*. This would be beneficial to the population providing more suitable habitats and holdfasts for individuals. It is therefore likely that a decrease in turbidity may benefit populations of *Hippocampus hippocampus*.
Water clarity decrease	No information on the specific effects of an increase in turbidity could be found. *Hippocampus hippocampus* is found in areas of low water flow rate and wave exposure and on substrata including silt and mud. Therefore is unlikely to be directly adversely affected by increases in turbidity at the benchmark level. However, light attenuation limits the depth to which seagrasses can grow as light is a requirement for photosynthesis. Turbidity resulting from dredging and eutrophication caused a massive decline of *Zostera* populations in the Wadden Sea (Geisen et al., 1990; Davison & Hughes, 1998). Seagrass populations are likely to survive short term increases in turbidity, however, a prolonged increase in light attenuation, especially at the lower depths of its distribution, will probably result in loss or damage of the population. This may cause a loss of habitat and hence displacement of *Hippocampus hippocampus*. Therefore intolerance has been assessed as low with a very high recovery.
Nutrient enrichment	As *Hippocampus hippocampus* is a predator it is not reliant on nutrients for growth, however, a change in nutrients would affect the quality of the water and the availability of the prey of *Hippocampus hippocampus*. However, no information was found concerning the direct effects of nutrients on

	Hippocampus hippocampus.
Habitat structure changes - removal of substratum (extraction)	*Hippocampus hippocampus* lives in a wide range of habitats from eelgrass, micro- and macro-algae to silt, mud and rocky substrata (N. Garrick-Maidment & Jones, 2004). A removal of the substratum, micro- or macro-algae or seagrasses would make an area unsuitable for seahorse colonization. However *Hippocampus hippocampus* is mobile and potentially able to find another site to recolonize. Therefore intolerance has been assessed as high with a high recoverability.
Heavy abrasion, primarily at the seabed surface	*Hippocampus hippocampus* is likely to be vulnerable to mobile fishing gear, for instance scallop dredging. Individuals may be crushed and killed but it is more likely that individuals would avoid the source of the disturbance. If a pregnant male is caught or killed the developing brood would also be lost. Intolerance has been assessed as intermediate with a moderate recoverability but with a very low confidence.
Light abrasion at the surface only	
Siltation rate changes	*Hippocampus hippocampus* can be found clinging by the tail to seagrasses and macroalgae. Seagrasses and macroalgae are intolerant of smothering and typically bend over with the addition of sediment and are buried in a few centimetres (Fonseca, 1992). However, it is more common to see all seahorse species at the base of the algae than at the end (N. Garrick-Maidment, pers. comm.). *Hippocampus hippocampus* will not be as affected by smothering as they are mobile and able to slowly swim away to another suitable area. Therefore, intolerance has been assessed as low with a very high recoverability.
	Hippocampus hippocampus does not rely on increases in suspended sediments to increase food availability as it feeds by predation. The seagrass habitats of *Hippocampus hippocampus* are likely to be intolerant of increases in suspended sediment which may result in a loss of habitat. However, *Hippocampus hippocampus* is mobile and may find more suitable conditions if necessary. Therefore, intolerance has been assessed as low with a very high recoverability.
	This species is probably tolerant of decreases in suspended sediment as it feeds by predation and is not reliant on food uptake through the sediments, however, its prey may be affected. Therefore, an assessment of low is given with a very high recoverability.
Introduction or spread of non-indigenous species	No information was found concerning the effects of alien species on *Hippocampus hippocampus.*
Removal of target species	*Hippocampus hippocampus* is targeted for extraction for trade as medicines, aquarium pets and curios. Seahorse populations are believed to have declined world-wide, although there is little quantitative harvest and trade data to support this (U.S. Fish & Wildlife Service, 2000). At least 20 million dried seahorses are traded world-wide annually (Lourie *et al.,* 1999). The majority of seahorses go to traditional Chinese medicine and its derivatives (e.g. Japanese and Korean traditional medicines). The impact of removing millions of seahorses can only be inferred indirectly because global seahorse numbers are unknown, and fisheries undocumented (Vincent, 1996). Europe primarily trades seahorses as curios and aquarium fishes. Each import shipment is small but total imports amount to hundreds of thousands of seahorses annually. The UK imports live seahorses from around the world. Records show that in 1994, 4000 seahorses were

	imported (Wilson, 1995; cited in Vincent, 1996). The British Isles is now being targeted for collection for the aquarium trade, with a small but significant number of animals being taken in Weymouth Bay in Dorset commercially (price reported as £65 per fish) and a handful of animals being taken by divers and fishermen particularly around the Channel Islands of Jersey and Guernsey (JNCC, 2002). Seahorse fisheries are individually small but collectively very large and potentially damaging to wild seahorse populations, which are often caught in trawls and seines. Trawling activities also damage the habitat of seahorses, for example, destroying seagrass beds. Extracting seahorses at the current rate appears to be having a serious effect on their populations (Vincent, 1996). Therefore, intolerance has been assessed as intermediate with a moderate recoverability.
Removal of non-target species	Although no information was found concerning the effects of extracting other species, it is known that sea horses are also caught as by-catch in trawls, seine and set nets in commercial fisheries directed at food fish or shrimps and prawns (Lourie *et al.,* 1999). Therefore, intolerance has been assessed as intermediate with a moderate recoverability.

3.12	***Leptopsammia pruvoti***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local	Observations from aquaria suggest that the species is very tolerant to temperature increases, tolerating up to about 30°C for several days. Similarly, observations from aquaria suggest that, once established it survives in temperatures below its normal range. *Leptopsammia pruvoti* distribution extends south into the Mediterranean where water temperatures are considerably warmer than in the British Isles. However, the species is at the northern limit of its range and long term chronic decreases in temperature would probably cause death. Gamete production, synchronous gamete production or successful recruitment are very unpredictable and sporadic primarily due to unfavourable environmental conditions. Local recruitment has not been recorded at Lundy during more than 12 years of monitoring but occurred to a small extent in 1998. Local recruitment is most likely but may also be from distant water bodies perhaps every 25-30 years. There has been no observation of colonization of wrecks or new natural surfaces near to existing colonies such as the breakwater at Plymouth Sound constructed in the early 1800's. Recovery will take a very long time or may not occur at all.
Salinity changes - local	The species is only found in fully saline environments and at depths unlikely to be affected by fresh water surface runoff (10-30m). Observations from aquaria suggest that these animals are quite tolerant to slight changes in salinity but reductions of one or two salinity bands are likely to cause death. Gamete production, synchronous gamete production or successful recruitment are very unpredictable and sporadic primarily due to unfavourable environmental conditions. Local recruitment has not been recorded at Lundy during more than 12 years of monitoring but occurred to a small extent in 1998. Local recruitment is most likely but may also be from distant water bodies perhaps every 25-30 years. There has been no observation of colonization of wrecks or new natural surfaces near to existing colonies such as the breakwater at Plymouth Sound constructed in the early 1800's. Recovery will take a very long time or may not occur at all.
Water flow (tidal current) changes - local	Decreases in flow rate are unlikely to have any effect as *Leptopsammia pruvoti* can be found in areas with negligible water flow. Increases in water flow rate may interfere with the ability to feed or to hold the tentacles out in the current. However, a thriving population has been found on the wave exposed west coast of Lundy. Reproduction may be restricted and body condition may be lost as a result of increases in water flow rate. On resumption of 'normal' water flow rates recovery will probably occur within a few months.
Emergence regime changes - local	The species is only found subtidally (typically 10-30m) and the polyp is soft bodied. Emersion from the water would cause death. Gamete production, synchronous gamete production or successful recruitment are very unpredictable and sporadic primarily due to unfavourable environmental conditions. Local recruitment has not been recorded at Lundy during more than 12 years of monitoring. Recruitment from distant water bodies may occur every 25-30 years. Recovery will take a very long time or may not occur at all.

Wave exposure changes - local	The species inhabits a range of wave exposures from exposed to sheltered. Decreases in wave exposure may not have any effect on the species but increases in wave exposure may affect the ability to feed and extend tentacles. However, a thriving population has been found on the wave exposed west coast of Lundy. Gamete production, synchronous gamete production or successful recruitment are very unpredictable and sporadic primarily due to unfavourable environmental conditions. Local recruitment has not been recorded at Lundy during more than 12 years of monitoring but occurred to a small extent in 1998. Local recruitment is most likely but may also be from distant water bodies perhaps every 25-30 years. There has been no observation of colonization of wrecks or new natural surfaces near to existing colonies such as the breakwater at Plymouth Sound constructed in the early 1800's. Recovery will take a very long time or may not occur at all.
Water clarity changes	*Leptopsammia pruvoti* tends to inhabit low light environments such as caves, crevices and overhangs. In the Mediterranean the species is found in very dark conditions (Riedl, 1966). If the presence of some light is of critical importance, increased light transmission may mean that (if recruitment occurs) the species can extend its depth range. In the clear waters of the western Mediterranean the lower depth limit is 40m as opposed to 30m elsewhere.
Heavy abrasion, primarily at the seabed surface	The calcified skeleton of this species is brittle. Physical disturbance or abrasion would cause detachment and death. Gamete production, synchronous gamete production, or successful recruitment are very unpredictable and sporadic primarily due to unfavourable environmental conditions. Local recruitment was not recorded at Lundy during more than 12 years of monitoring but occurred to a small extent in 1998. Local recruitment is likely but may also occur from distant water bodies perhaps every 25 -30 years. There has been no observation of colonization of wrecks or new natural surfaces near to existing colonies such as the breakwater at Plymouth Sound constructed in the early 1800's (Keith Hiscock pers obs.). Recovery will take a very long time or may not occur at all.
Light abrasion at the surface only	
Siltation rate changes	This species is permanently attached to the substratum and would be unable to avoid or 'dig-out' from smothering. Gamete production, synchronous gamete production or successful recruitment are very unpredictable and sporadic primarily due to unfavourable environmental conditions. Local recruitment has not been recorded at Lundy during more than 12 years of monitoring but occurred to a small extent in 1998. Local recruitment is most likely but may also be from distant water bodies perhaps every 25-30 years. There has been no observation of colonization of wrecks or new natural surfaces near to existing colonies such as the breakwater at Plymouth Sound constructed in the early 1800's. Recovery will take a very long time or may not occur at all.
	This species is permanently attached to the substratum and would be unable to avoid changes in siltation. However, the species tends to inhabit caves or overhangs which are less likely to be exposed to suspended material settling out. The polyp will most likely 'inflate' with water to expand above the silt if briefly covered. Increased siltation may clog feeding apparatus and there would be an energetic cost to clearing this sediment. Gamete production, synchronous gamete production or successful recruitment are very unpredictable and sporadic primarily due to unfavourable environmental conditions. Local recruitment has not been recorded at Lundy during more than 12 years of monitoring but occurred to a small extent in 1998. Local recruitment is most likely but may also be from distant water bodies perhaps

	every 25-30 years. There has been no observation of colonization of wrecks or new natural surfaces near to existing colonies such as the breakwater at Plymouth Sound constructed in the early 1800's. Recovery will take a very long time or may not occur at all.
Removal of target species	It is extremely unlikely that *Leptopsammia pruvoti* would be extracted. The species is the subject of a UK Biodiversity Action Plan.
Removal of non-target species	*Leptopsammia pruvoti* has no known obligate relationships so removal of other species is unlikely to have any effect on the population.

3.13	***Lithothamnion corraloides***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local	Temperature increases are likely to have little effect. Growth is optimal between 15 and 20 ºC (typically higher than water temperatures found round the British Isles). Decreases in temperature may be important. The minimum survival temperature for *Lithothamnion corallioides* is between 2 and 5 ºC. This species is absent from Scotland either because water temperatures occasionally drop below this minimum or because temperatures do not remain high enough for long enough to support sufficient annual growth. *Lithothamnion corallioides* is more intolerant than *Phymatolithon calcareum* to decreases in temperature. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Lithothamnion corallioides* means that vegetative regeneration will take a long time.
Salinity changes - local	*Lithothamnion corallioides* is found only in fully saline waters (between 30-40 psu). Growth of some maerl species is impaired below 24 psu. Reduction in salinity for a year would probably kill the population. Reproduction is virtually unknown in British Isles populations. Once a population has become extinct, the lack of propagules means that it is unlikely that it will be re-established. Even if reproductive propagules arrive from elsewhere, with the very slow growth rate of *Lithothamnion corallioides*, it will take a very long time to re-establish a similar population.
Water flow (tidal current) changes - local	Changes in water flow rate are unlikely to have a direct effect on *Lithothamnion corallioides* but the consequences of a reduction in water flow rate may. Reduced water flow would allow greater build up of deposited particulate matter effectively covering the algae and restricting photosynthesis. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Lithothamnion corallioides* means that vegetative regeneration will take a long time.
Emergence regime changes - local	Maerl species (unlike most seaweeds) have a very poor ability to tolerate emersion - only a few minutes exposure to the air would be sufficient to cause death. Reproduction is virtually unknown in British Isles populations. Once a population has become extinct, the lack of propagules means that it is unlikely that it will be re-established. Even if reproductive propagules arrive from elsewhere, with the very slow growth rate of *Lithothamnion corallioides*, it will take a very long time to re-establish a similar population.
Wave exposure changes - local	Maerl is restricted to less wave exposed areas. Strong wave action can break up the nodules into smaller pieces and scatter them from the maerl bed. *Lithothamnion corallioides* is less tolerant of high wave exposure than *Phymatolithon calcareum*. Wave action during storms can be very important in determining the loss rates of thalli from maerl beds. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Lithothamnion corallioides* means that vegetative regeneration will take a long time.

Water clarity changes	The low water clarity of coastal waters (limiting photosynthesis) restricts the distribution of maerl in the British Isles to shallow waters - typically less than 10 metres. An increase in turbidity would further restrict the depth distribution of a population. A decrease in turbidity would benefit the population, facilitating photosynthesis. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Lithothamnion corallioides* means that vegetative regeneration will take a long time.
Habitat structure changes - removal of substratum (extraction)	Loss of the substratum (which may include maerl itself) will also cause loss of the living *Lithothamnion corallioides*. Because the species is photosynthetic it is only found on the surface of the maerl bed or other substratum. Reproduction is virtually unknown in British Isles populations. Once a population has become extinct, the lack of propagules means that it is unlikely that it will be re-established. Even if reproductive propagules arrive from elsewhere, with the very slow growth rate of *Lithothamnion corallioides*, it will take a very long time to re-establish a similar population.
Heavy abrasion, primarily at the seabed surface	Boat moorings and dragging anchor chains have been noted to damage the surface of maerl beds as has demersal fishing gear. Hall-Spencer & Moore (2000a, c) reported that a single pass of a scallop dredge could bury and kill 70% of the living maerl (usually found at the surface), redistributed coarse sediment and affected the associated community. Dredge tracks remained visible for 2.5 years. Hall-Spencer & Moore (2000a, c) suggested that repeated anchorage could create impacts similar to towed fishing gear. Overall, Hall-Spencer & Moore (2000a, c) concluded that maerl beds were particularly vulnerable to damage from scallop dredging activities. Therefore, intolerance has been recorded as high. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Lithothamnion corallioides* means that vegetative regeneration will take a long time.
Siltation rate changes	Smothering will block light penetration to the algal thalli preventing photosynthesis. Reproduction is virtually unknown in British Isles populations. Once a population has become extinct, the lack of propagules means that it is unlikely that it will be re-established. Even if reproductive propagules arrive from elsewhere, with the very slow growth rate of *Lithothamnion corallioides*, it will take a very long time to re-establish a similar population.
Introduction of microbial pathogens	No diseases of European maerl species are known. However, the bacterial pathogen 'coralline lethal orange disease' from the Pacific is highly virulent. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Lithothamnion corallioides* means that vegetative regeneration will take a long time.
Removal of target species	Harvesting of maerl is one of the greatest threats. In England only dead maerl is extracted. However, even this can have detrimental effects, re-suspending sediments that resettle and cover the algae reducing photosynthesis. In live beds the living nodules are typically on the surface so these are the first to be removed. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Lithothamnion corallioides* means that vegetative regeneration will take a long time.
Removal of non-target species	Extraction of other organisms such as scallops using dredges can cause great damage through physical disruption, crushing, burial and the loss of stabilising algae. Other large burrowing bivalves such as *Ensis sp.* and

	Venerupis sp. are harvested using suction dredging which causes structural damage and resuspends sediment that resettles, covering the algae and reducing photosynthesis. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Lithothamnion corallioides* means that vegetative regeneration will take a long time.

3.14	***Nematostella vectensis***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local	Living in eurythermal environments, *Nematostella vectensis* is very tolerant to temperature change. *Nematostella vectensis* has been found in temperatures ranging from -1 to 28°C (Williams, 1991; Hand & Uhlinger, 1992). Temperatures above 28°C were found to adversely affect the animals in the laboratory (Fritzenwanker & Technau, 2002), although no further information was given. Furthermore, the species has reportedly survived freezing at -5°C for 48 hours (M. Sheader, pers. comm.). A short term acute change in temperature may result in the loss of some of the population and intolerance has therefore been assessed as intermediate. Longer term changes will probably have little or no effect. Assuming a portion of the population remains, recoverability should be fairly high through asexual reproduction.
Salinity changes - local	*Nematostella vectensis* is a euryhaline species and, in England, has been recorded from 8.96 to 51.54 ppt (Williams, 1991), although the greatest abundances have been found in ponds varying seasonally between 16-36 ppt (Sheader *et al.*, 1997). Field observations indicate that above 40 ppt, tentacles are retracted and feeding ceases (Sheader *et al.*, 1997). In laboratory cultures from American specimens, salinity had a pronounced effect on both reproduction and the health of the animal itself (Hand & Uhlinger, 1992). For example, up to 20% of anemones in 10 and 20% seawater were deflated and had mesenteries everted through their mouths within 5 weeks. At the other extreme, anemones in 125 % seawater had decreased in size after 4 months and only spawned once, although asexual reproduction was not markedly less effective than at 33% seawater. Overall, the American studies found that asexual division was recorded, albeit at varying levels of success, at salinities between 7-42 ‰ and sexual reproduction between 12-34 ‰. Salinity varies depending on the geographical location of each population. At Keyhaven-Pennington in Hampshire, for example, salinity varies from 2-25 ppt whereas at the Fleet in Dorset, salinity varies between 18-32 ppt. Changes in salinity, at the benchmark level, are therefore likely to affect different populations in different ways, depending on the salinity regime they are adapted to and, therefore, an intolerance of intermediate has been recorded. Assuming some portion of the population remains, recoverability is likely to be high through asexual reproduction.
Water flow (tidal current) changes - local	*Nematostella vectensis* only inhabits areas that are ultra sheltered and have very low water flow rates (Sheader *et al*., 1997). Extreme shelter is needed as it allows a layer of fine mud to build up, in which the animal burrows (Williams, R.B., 1983). In the UK, *Nematostella vectensis* was found to be absent from areas where water flow exceeded 0.18 cm/s (Sheader *et al*., 1997) and is likely to be highly intolerant to changes in water flow rate at the benchmark level. Dispersal is very limited due to the isolated nature of suitable habitat, lack of a dispersive phase in UK populations, and preponderance of asexual reproduction. Recovery is therefore likely to be very low.

Emergence regime changes - local	*Nematostella vectensis* populations remain submerged throughout the tidal cycle and are therefore likely to be intolerant to increased emergence at the benchmark level. Mortality is likely to be high at the upper limit of the population distribution. A decrease in emergence may extend the lower limit of the population providing suitable substratum remained. However, intolerance has been assessed as high to reflect the mortality associated with increased emergence. Dispersal is very limited due to the isolated nature of suitable habitat, lack of a dispersive phase in some populations, and preponderance of asexual reproduction. Recovery is therefore likely to be very low.
Wave exposure changes - local	*Nematostella vectensis* only inhabits areas that are ultra sheltered and have very low water flow rates (Sheader *et al.*, 1997). Extreme shelter is needed as it allows a layer of fine mud to build up, in which the animal burrows (Williams, R.B., 1983). The animal is highly intolerant to increases in water flow rate (see water flow rate) and therefore likely to be highly intolerant to increases in wave exposure for the same reasons. Williams (1991) suggested that heavy wave exposure is likely to be a limiting factor in the distribution of this species. Dispersal is very limited due to the isolated nature of suitable habitat, lack of a dispersive phase in UK populations, and preponderance of asexual reproduction. Recovery is therefore likely to be very low.
Water clarity changes	*Nematostella vectensis* has no visual ability other than to perhaps determine direction of light. Changes in light attenuation through cause by changes in the level of turbidity are, therefore, unlikely to have any effect and accordingly, tolerant has been recorded.
Heavy abrasion, primarily at the seabed surface	Although this species can retract into its burrow on disturbance, its small size and soft bodied nature mean that physical disturbance is likely to adversely affect individuals. A proportion of the population is likely to be killed and, therefore, intolerance has been assessed as intermediate. Given the high local abundance commonly associated with this species (see adult general biology), a proportion of the population is likely to remain and recoverability is likely to be high through asexual reproduction.
Light abrasion at the surface only	
Siltation rate changes	*Nematostella vectensis* typically burrows in mud and it is likely that most individuals would be able to move up through the smothering material. However, some mortality may be expected due to the small size of the animals and smothering by heavier material such as tar is likely to increase mortality. Intolerance has therefore been assessed as intermediate. Populations should recover relatively rapidly through asexual reproduction.
	Increases in siltation may interfere with feeding by clogging up the feeding apparatus. There may be an energetic cost associated with clearing the feeding apparatus. However, this is likely to be slight as the anemone is a sediment burrowing species used to dealing with particulate matter. Over the duration of benchmark some reductions in growth or reproduction may be observed. The amount of available food has been found to be linked to the frequency of fission and starvation can suppress the process (Hand & Uhlinger, 1995). An intolerance of low has been recorded to reflect a reduction in the viability of the population. Recovery is expected to be immediate on resumption of normal levels of suspended sediment.
Underwater noise changes	*Nematostella vectensis* is probably responsive to localised vibration, which is likely to cause it to withdraw into the substratum. However, it is unlikely to perceive noise at the benchmark level.

Visual disturbance	*Nematostella vectensis* has no visual ability other than to p erhaps determine direction of light. This species is therefore likely to be tolerant of visual presence at the benchmark level.
Introduction or spread of non-indigenous species	Insufficient information
Introduction of microbial pathogens	Insufficient information
Removal of target species	Targeted extraction of this species is highly unlikely.
Removal of non-target species	During perio ds of reduced oxygen concentrations, algae m ay be used as a preferential substratum. Removal of these alga e may result in interme diate intolerance in times of low oxyge nation. Assuming some portion of the population remains, recoverability should be high through asexual reproduction.

3.15	*Ostrea edulis*
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	Temperature and salinity are the most significant abiotic factors affecting *Ostrea edulis* (Valero, 2006). Filtration rate, metabolic rate, assimilation efficiency and growth rates of adult *Ostrea edulis* increase with temperature and growth was predicted to be optimal at 17°C or for short periods at 25°C (Korringa, 1952; Yonge, 1960; Buxton *et al.*, 1981; Hutchinson & Hawkins, 1992; Grant *et al.*, 1990). Huchinson & Hawkins (1992) noted that temperature and salinity were co-dependant, so that high temperatures and low salinity resulted in marked mortality, no individuals surviving more than 7 days at 16psu and 25°C, although these conditions rarely occurred in nature. No upper lethal temperature was found although Kinne (1970) reported that gill tissue activity fell to zero between 40-42°C; although values derived from single tissue studies should be viewed with caution. Buxton *et al.* (1981) reported that specimens survived short term exposure to 30°C. However, *Ostrea edulis* occurs from the Mediterranean to the Norwegian coast and is unlikely to be adversely affected by long term changes in temperatures in the UK. Spärck's data (1951) suggest that temperature is an important factor in recruitment, especially at the northern extremes of its range and Korringa (1952) reported that warm summers resulted in good recruitment. Spawning is initiated once the temperature has risen to 15-16°C, although local adaptation is likely (Korringa, 1952; Yonge, 1960), and minimum temperatures required for spawning in France are 14-16°C, with gametogenesis occurring at 10°C (FAO, accessed 2009). Davis & Calabrese (1969) reported that larvae grew faster with increasing temperature and that survival was optimal between from 12.5 - 27.5°C but that survival was poor at 30°C. Therefore, recruitment and the long term survival of an oyster bed is probably affected by temperature and may benefit from long term increases. Once the temperature returns to normal limits the characterizing species will probably regain their condition rapidly.
Temperature changes - local decrease	Growth rates are usually slower, mortality increased and spawning less frequent and reliable with low temperatures (Valero, 2006). Hutchinson & Hawkins (1992) suggested that *Ostrea edulis* switched to a reduced, winter metabolic state below 10°C that enabled it to survive low temperatures and low salinities encountered in shallow coastal waters around Britain. Davis & Calabrese (1969) also noted that larval survival was poor at 10°C. Korringa (1952) reported that British, Dutch and Danish oysters can withstand 1.5°C for several weeks. Korringa (1952) also reported *Ostrea edulis* form waters of -1°C. However, heavy mortalities of native oyster were reported after the severe winters of 1939/40 (Orton, 1940) and 1962/63 (Waugh, 1964). Mortality was attributed to relaxation of the adductor muscle so that the shell gaped, resulting in increased susceptibility to low salinities as the ice melted or to clogging with silt. Low temperatures and cold summers are also correlated with poor recruitment, presumably due to reduced food availability and longer larval developmental time, especially at the northern limits of its range. Therefore, a reduction in temperature may result in reduced recruitment and a greater variation in the populations of *Ostrea edulis*. Hence an intolerance of intermediate has been recorded. Recruitment in *Ostrea edulis* is sporadic and dependant of the hydrographic regime and local environmental conditions but will be enhanced by the presence of adults and shell material. Therefore a recoverability of low has been recorded (see additional information below).

Salinity changes - local increase	Temperature and salinity are the most significant abiotic factors affecting *Ostrea edulis* (Valero, 2006). *Ostrea edulis* is found subtidally in full to variable salinity waters and is unlikely to experience increased salinity waters. Therefore intolerance is assessed as low. Recovery would be very high, yielding a very low sensitivity value. Hyper-saline effluent may be damaging but no information concerning the effects of increased salinity on oyster beds was found.
Salinity changes - local decrease	*Ostrea edulis* is euryhaline and colonizes estuaries and coastal waters exposed to freshwater influence (Yonge, 1960), although the species has a preference for more fully saline conditions (Laing et al. 2005), and low salinity results in a cessation of feeding (Korringa, 1952). Yonge (1960) reported that the flat oyster could not withstand salinities below 23 psu. Hutchinson & Hawkins (1992) noted that scope for growth was severely affected below 22psu, probably because the oyster's valves were closed, but that 19 -16 psu could be tolerated if the temperature did not exceed 20°C. At 25°C animals did not survive more than 7 days at 16psu. Hutchinson & Hawkins (1992) noted that at low temperatures (10°C or less) the metabolic rate was minimal, which would help. *Ostrea edulis* survive in low salinities associated with storm runoff in the winter months. Further, in low salinity conditions, the mortality rate of spat is lower at 5°C than at 10°C (Rödström and Jonsson, 2000). *Ostrea edulis* larva may grow at salinities of 20 psu, but can survive salinities as low as 15 psu (FAO, accessed 2009). However, larvae do not survive at very low salinity although they will settle in low salinity waters; otherwise they could not colonize estuarine waters (Yonge, 1960). Therefore, an intolerance of low has been recorded.
Water flow (tidal current) changes - local increase	Hydrodynamic currents supply food and oxygen to *Ostrea edulis*. Increases in water flow may improve the availability of suspended particles on which the oyster feeds. With increased water flow rate the oysters filtration rate increases, up to a point where the oysters are unable to remove more particles from the passing water (Walne, 1979). However increases in water flow rate may interfere with settlement of spat. Growth rates of *Ostrea edulis* are faster in sheltered sites than exposed locations, however this is thought to be attributed to the seston volume rather than flow speed or food availability (Valero, 2006). Decreased water flow may result in increased siltation and consequential changes in substratum type. This may result in reduced weight, condition and fecundity. Therefore intolerance is assessed as low. Once 'normal' conditions are restored then normal feeding will allow condition to be restored, hence recovery is very high, yielding a very low sensitivity value.
Emergence regime changes - local increase	The adult oyster can close the valves of its shell tightly when exposed. Some populations are found in the lower intertidal. A change of one hour in exposure would mean that the valves are kept shut for a greater or lesser time. Increases in emergence would result in less time available for feeding. Individuals already at the limit of their emergence tolerance would die under further increases in emergence. The native oyster does have a pelagic larval phase which can disperse over large distances to augment populations. It is also highly fecund and spawns regularly. However, dominance of other species such as *Crepidula fornicata* following reduction in oyster populations can restrict re-establishment of former levels, through changes to the environment and competition. Native and introduced predators can also restrict re-establishment. If populations have been reduced considerably then the standing stock may be insufficient to ensure synchronous and successful spawning. Because the adults are cemented to the substratum, adult immigration is not possible.

Emergence regime changes - local decrease	A decrease in emergence regime may allow the oyster beds to extend their range up the shore in suitable conditions. Therefore, tolerant is recorded.
Wave exposure changes - local increase	The native oyster occurs in areas with wave exposure ranging from exposed to extremely sheltered. Increases in wave exposure to levels greater than this are likely to cause death. Settlement of spat may be hindered, young oysters may be damaged or displaced by the wave action. The native oyster does have a pelagic larval phase which can disperse over large distances to augment populations. It is also highly fecund and spawns regularly. However, dominance of other species such as *Crepidula fornicata* following reduction in oyster populations can restrict re-establishment of former levels, through changes to the environment and competition. Native and introduced predators can also restrict re-establishment. If populations have been reduced considerably then the standing stock may be insufficient to ensure synchronous and successful spawning. Because the adults are cemented to the substratum, adult immigration is not possible.
Wave exposure changes - local decrease	Decreases in wave exposure are unlikely to have any effect on the population.
Water clarity decrease	The native oyster has no dependence on light availability so changes in turbidity would have no effect. However, increased turbidity may decrease primary production by phytoplankton and hence food availability. Therefore, an intolerance of low has been recorded. Once conditions returned to prior levels condition would probably be recovered rapidly.
Nutrient enrichment	The species can do well in estuarine environments which frequently have higher levels of nutrients than the open coast. Nutrient concentration may have no effect on the oysters themselves. However, the oysters may benefit indirectly through the enhanced growth of microalgae (on which they feed) with increased levels of nutrients. Long term or high levels of organic enrichment may result in eutrophication and have indirect adverse effects, such as increased turbidity, increased suspended sediment (see above), increased risk of deoxygenation (see below) and the risk of algal blooms. *Ostrea edulis* has been reported to suffer mortality due to toxic algal blooms, e.g. blooms of *Gonyaulax* sp. and *Gymnodinium* sp. (Shumway, 1990). The subsequent death of toxic and non-toxic algal blooms may result in large numbers of dead algal cells collecting on the sea bottom, resulting in local de-oxygenation as the algal decompose, especially in sheltered areas with little water movement.
Habitat structure changes - removal of substratum (extraction)	This species typically cements itself to the substratum on metamorphosis so loss of the substratum would cause death of the population. The native oyster does have a pelagic larval phase which can disperse over large distances to re-establish populations. It is also highly fecund and spawns regularly. However, dominance of other species such as *Crepidula fornicata* following loss of the oyster population can prevent re-establishment, through changes to the environment and competition. Because the adults are cemented to the substratum, adult immigration is not possible. Native and introduced predators can also restrict re-establishment. Habitat management may be required in order to allow oysters to re-colonize an area.

Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	The native oyster has a calcareous shell that can get very thin in older individuals. The shell may be brittle. Abrasion may cause damage to the shell, particularly to the growing edge. Regeneration and repair abilities of the oyster are quite good. Power washing of cultivated oysters routinely causes chips to the edge of the shell increasing the risk of desiccation. This damage is soon repaired by the mantle. However, a passing scallop dredge is likely to remove a proportion of the population. On mixed sediments, the dredge may remove the underlying sediment and cobbles and shell material with effects similar to substratum loss above. Therefore, an intolerance of intermediate has been recorded. See 'extraction' below for the effects of fishing on native oyster populations. The native oyster does have a pelagic larval phase which can disperse over large distances to augment populations. It is also highly fecund and spawns regularly. However, dominance of other species such as *Crepidula fornicata* following reduction in oyster populations can restrict re-establishment of former levels, through changes to the environment and competition. Native and introduced predators can also restrict re-establishment. If populations have been reduced considerably then the standing stock may be insufficient to ensure synchronous and successful spawning. Because the adults are cemented to the substratum, adult immigration is not possible.
	Smothering by 5 cm of sediment would prevent the flow of water through the oyster that permits respiration, feeding and removal of waste. *Ostrea edulis* is permanently fixed to the substratum and would not be able to burrow up through the deposited material. *Ostrea edulis* can respire anaerobically, and is known to be able to survive for many weeks (Yonge, 1960) or 24 days (Korringa, 1952) out of water at low temperatures used for storage after culture. However, it is likely that at normal environmental temperatures, the population would be killed by smothering. Yonge (1960) reported death of populations of *Ostrea edulis* due to smothering of oyster beds by sediment and debris from the land after flooding due to exceptionally high tides in 1953. Even small increases in sediment deposition have been found to reduce growth rates in *Ostrea edulis* (Grant *et al.*, 1990). Therefore, an intolerance of high has been recorded.
Siltation rate changes	Oysters can reject unwanted particles (Yonge, 1926) and respond to an increase in suspended sediment by increasing pseudofaeces production with occasional rapid closure of their valves to expel accumulated silt (Yonge, 1960) both of which exert an energetic cost. Korringa (1952) reported that an increase in suspended sediment decreased the filtration rate in oysters. This study is supported by Grant *et al.* (1990) who found declining clearance rates in *Ostrea edulis* in responds to an increase in suspended particulate matter. Suspended sediment was also shown to reduce the growth rate of adult *Ostrea edulis* and results in shell thickening (Moore, 1977). Reduced growth probably results from increased shell deposition and an inability to feed efficiently. Hutchinson & Hawkins (1992) reported that filtration was completely inhibited by 10 mg/l of particulate organic matter and significantly reduced by 5 mg/l. *Ostrea edulis* larvae survived 7 days exposure to up to 4 g/l silt with little mortality. However, their growth was impaired at 0.75 g/l or above (Moore, 1977). *Ostrea edulis* is less well adapted to silted conditions than other species, e.g. *Crassostrea virginica* (Yonge, 1960). Yonge (1960) and Korringa (1952) considered *Ostrea edulis* to be intolerant of turbid environments. For example, Yonge (1960) reported smothering of oyster beds after flooding (see above). However, oyster beds are found in the relatively turbid estuarine environments and the values of suspended sediment quoted above are high in comparison to the benchmark value. Therefore, a change in suspended sediment at the benchmark level may only

	result in sub-lethal effects and an intolerance of low has been recorded. Moore (1977) reported that variation in suspended sediment and silted substratum and resultant scour was an important factor restricting oyster spatfall, i.e. recruitment. Therefore, an increase in suspended sediment may have longer term effects of the population by inhibiting recruitment, especially if the increase coincided with the peak settlement period in summer. Once 'normal' conditions are restored then normal feeding will resume.
Visual disturbance	This species probably has very limited ability for visual perception.
Removal of target species	British native oyster beds (characteristic of this biotope) were exploited in Roman times. However, the introduction of oyster dredging in the mid 19th century, and the accompanying improvement in rail transport developed the oyster beds into a major fishery. By the late 19th century stocks were beginning to be depleted so that by the 1950s the native oyster beds were regarded as scarce (Korringa, 1952; Yonge, 1960; Edwards, 1997). This biotope is still regarded as scarce today. Overfishing, combined with reductions in water quality, cold winters (hence poor spatfall), flooding, the introduction of non-native competitors and pests (see above), outbreaks of disease and severe winters was blamed for the decline (Korringa, 1952; Yonge, 1960; Edwards, 1997). As a result, although 700 million oysters were consumed in London alone in 1864, the catch fell from 40 million in 1920 to 3 million in the 1960s, from which the catch has not recovered (Edwards, 1997). Therefore, while overfishing was not the sole cause of the overall decline of UK *Ostrea edulis* population it was nevertheless a major contributing factor. Therefore, although the benchmark would otherwise result in an intolerance of intermediate, due to the demonstrable potential effects of fishing on this species, an intolerance of high has been recorded. Recovery is dependant on larval recruitment since the adults are permanently attached and incapable of migration. Recruitment is sporadic and dependant on the local environmental conditions, hydrographic regime and the presence of suitable substratum, especially adult shells or shell debris, and has probably been inhibited by the presence of competition from non native species (see additional information below). Therefore, a recoverability of very low has been suggested.
Removal of non-target species	No species associated with oyster beds are known to be subject to extraction.

3.16	*Palinurus elephas*
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	*Palinurus elephas* is found in warmer waters as far south as the western basin of the Mediterranean and long term temperature increases may have little effect on survival of British populations. No information was found concerning the effects of acute temperature changes on *Palinurus elephas* however, tolerant has been suggested.
Temperature changes - local decrease	In Britain, *Palinurus elephas* is towards the most northerly limit of its distribution. It lives predominantly around exposed extremities of land protruding into the north Atlantic and, therefore, it is highly likely that long term climate change would affect its distribution (Hunter, pers. comm.). Decreases in temperature may result in a further reduction of population distribution in the British Isles. In terms of acute change, Crisp (1964a) reported that *Palinurus elephas* (studied as *Palinurus vulgaris*) held in the aquarium of the Marine Biological Station on the Isle of Man died during the severe winter of 1962-63. The water in the aquarium was supplied directly from Port Erin Bay which dropped to 3.5°C (the coldest since records began 60 years previously). In light of the benchmark for an acute change in temperature (a reduction in temperature of 5°C for 3 days), an intolerance of high has been suggested. *Palinurus elephas* reproduces annually and the eggs are incubated by the female. However, even if suitable environmental conditions permitted, recovery for larger individuals over ca five years old would probably be moderate.
Salinity changes - local increase	*Palinurus elephas* inhabits oceanic waters that are of full salinity. In this habitat, it is unlikely to be subjected to further increases in salinity, therefore this factor is considered irrelevant.
Salinity changes - local decrease	*Palinurus elephas* inhabits oceanic waters that are of full salinity. Changes outside these conditions would probably cause migration to areas of full salinity. This abnormal migration may interfere with feeding and reproduction and an intolerance of low has been suggested although there is no evidence to support this. Recovery is likely to occur as soon as normal conditions return.
Water flow (tidal current) changes - local increase	No information was found concerning the tidal strength preferences of *Palinurus elephas* although it has been found in habitats with water flows ranging from very weak to very strong (JNCC, 1999). It may be protected, to a certain extent, from increases in water flow rate due to their habitat in rock crevices, however, insufficient information was available to be able to assess sensitivity if such refuges were unavailable.
Water flow (tidal current) changes - local decrease	No information was found concerning the tidal strength preferences of *Palinurus elephas* although it has been found in habitats with water flows ranging from very weak to very strong (JNCC, 1999). It is possible that extremely low flow rates may hinder passive dispersal of the pelagic phyllosoma larvae, however, for the adults, a decrease in water flow rate is unlikely to be important and, therefore, tolerant has been suggested.
Emergence regime changes - local increase	*Palinurus elephas* is sufficiently mobile to be able to avoid an increase in emergence and, therefore, is recorded as being tolerant to a change in emergence.
Emergence regime changes - local	*Palinurus elephas* is found sublittorally and so will not be affected by an decrease in emergence at the benchmark level.

decrease	
Wave exposure changes - local increase	*Palinurus elephas* tends to live in very wave exposed coastal areas but no information was found concerning the effects of an increase in wave exposure. However, it is unlikely that an increase in wave exposure would adversely affect *Palinurus elephas*.
Wave exposure changes - local decrease	*Palinurus elephas* tends to live in very wave exposed areas and a decrease in wave exposure by two categories would result in the species being subjected to conditions outside its preferred range. However, no information was found to suggest that *Palinurus elephas* would be adversely affected by such a change and it is likely that it would be tolerant.
Water clarity increase	No information was found concerning the effects of a decrease in turbidity on *Palinurus elephas*.
Water clarity decrease	No information was found concerning the effects of an increase in turbidity on *Palinurus elephas*.
Habitat structure changes - removal of substratum (extraction)	Although removal of the substratum would most probably displace the lobsters, their mobility means that substratum loss *per se* is unlikely to adversely affect them and not relevant has been suggested. However, the act of physically removing the substratum e.g. by dredging, may affect the lobsters (see Physical Disturbance).
Heavy abrasion, primarily at the seabed surface Light abrasion at the surface only	*Palinurus elephas* has a tough cuticular exoskeleton. At the benchmark level, some damage may occur, for example broken legs, but is unlikely to cause death in the majority of the population. Furthermore, the lobsters are likely to be protected from abrasion, to a certain extent, from their habitat in crevices and in rocky environments. An intolerance of low has been suggested with very low confidence. Crustaceans are able to regenerate damaged / lost appendages and recovery is expected to be very high.
Siltation rate changes	The species is quite large and mobile. Smothering by 5 cm of sediment is unlikely to adversely affect adult *Palinurus elephas* and tolerant has been suggested.
	An increase in the amount of suspended sediment is unlikely to affect *Palinurus elephas* directly. However, over the course of the benchmark, and depending on local hydrographic conditions, siltation may occur on the rocky substratum on which this species prefers. An increase in the amount of fine particulates, although unlikely to significantly change the nature of the substratum over the benchmark period, may alter the proportion of different prey items available to the lobster. However, since *Palinurus elephas* are active omnivores, such a change is unlikely to reduce total ingestion over the benchmark period and tolerant has been suggested.
	A decrease in the amount of suspended sediment is unlikely to affect *Palinurus elephas* directly and, therefore, tolerant has been suggested.
Introduction or spread of non-indigenous species	Insufficient information was found on diseases to make an assessment. However, the species is susceptible to crustacean shell disease, which is characterised by brown spots that erode away the exoskeleton. These lesions are often found to contain chitinoclastic bacteria, and additionally Alderman (1973) recorded the presence of a fungus bearing septate mycelium.
Introduction of microbial pathogens	Insufficient information was found on diseases to make an assessment. However, the species is susceptible to crustacean shell disease, which is characterised by brown spots that erode away the exoskeleton. These lesions are often found to contain chitinoclastic bacteria, and additionally Alderman (1973) recorded the presence of a fungus bearing septate mycelium.

Removal of target species	This species is taken both as a targeted species and as a by-catch from other fisheries. Intensive potting (creeling), diving and tangle or trammel netting for *Palinurus elephas* has contributed to a very substantial decline in population size since the 1970's (K. Hiscock, pers. comm.) and intolerance has been assessed as intermediate. Despite the fact that *Palinurus elephas* reproduces annually and the eggs are incubated by the female, the lack of recovery after substantial exploitation in the 1970's suggests that recovery is low. Therefore although intolerance has been assessed as intermediate, the overall sensitivity will be high.
Removal of non-target species	*Palinurus elephas* is taken as a by-catch from fisheries for other species and intolerance has been assessed as intermediate. The species reproduces annually and the eggs are incubated by the female. Suitable environmental conditions permitting, the population should recover within a few years. However, in view of lack of recovery after substantial exploitation in the 1970's (K. Hiscock, pers. comm.), recovery has been assessed as low.

3.17	***Paludinella littorina***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local	The species reaches the northern limits of its distribution in England so may be particularly intolerant of reductions in temperature. The species would be protected from extremes in temperature where it lives in shingle or in crevices and caves.
Salinity changes - local	*Paludinella litorina* can tolerate a wide range of salinities as evidenced by its distribution in lagoons and on open shore. The species may not be able to withstand low salinity for long periods of time.
Water flow (tidal current) changes - local	Living at the high water mark, the species is inundated for only short periods so that increased water flow is unlikely to have a significant effect unless it is so great as to erode the substrate and wash animals away.
Emergence regime changes - local	Increased or decreased emergence is likely to occur on a relatively long time scale during which the habitat and animals will probably be able to re-adjust.
Wave exposure changes - local	Increased wave action may damage or wash away this species or move shingle, damaging the animal by abrasion.
Water clarity changes	The species will probably not be affected by a change in turbidity as it is not dependant on light availability.
Habitat structure changes - removal of substratum (extraction)	*Paludinella litorina* would be removed upon substratum loss. Light & Killeen (1997) suggest that cliff instability may be the main threat to those colonies. Recoverability would be low because populations of the species are sparse.
Siltation rate changes	Smothering could block shingle interstices, prevent movement of the snail and reduce level of oxygenation. Recovery would be low because it probably lacks an aquatic dispersal phase and other colonies are distant.
	The species should be able to move through new silt and may be able to feed on it, so long as interstices remain clear.
Visual disturbance	Insufficient information
Introduction or spread of non-indigenous species	Insufficient information
Introduction of microbial pathogens	Insufficient information
Removal of target species	NR
Removal of non-target species	Would cause huge disturbance and damage but is unlikely.

3.18	***Phymatolithon calcareum***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local	Temperature increases are likely to have little effect. Growth is optimal between 15 and 20°C (typically higher than water temperatures found round the British Isles). Decreases in temperature may be important. The minimum survival temperature for *Phymatolithon calcareum* is between 0.4 and 2°C. Although *Phymatolithon calcareum* is less intolerant of decreases in temperature than *Lithothamnion corallioides* some individuals may still die. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Phymatolithon calcareum* means that vegetative regeneration will take a long time.
Salinity changes - local increase	*Phymatolithon calcareum* is found in full salinity waters in open coastal areas so that increase in salinity is considered not relevant.
Salinity changes - local decrease	*Phymatolithon calcareum* is found in fully saline waters (between 30-40 psu). Adey & McKibbon (1970) studied growth rates of *Phymatolithon calcareum* under lowered salinity conditions. *Phymatolithon calcareum* showed low growth rates at 24 psu and did not grow at 13 psu. On return to full salinity, plants did not continue growing after one month but appeared healthy. It therefore appears that *Phymatolithon calcareum* is tolerant of at least short term significant reduction in salinity (of the sort that might occur in enclosed sounds after heavy rainfall runoff) and is tolerant of slightly lowered salinity over a long period. Intolerance is therefore determined to be low. Recovery (in terms of return to normal growth rates following increase in salinity) seems to be delayed according to the work of Adey & McKibbin (1970) but is most likely within a few months and therefore very high.
Water flow (tidal current) changes - local	Changes in water flow rate are unlikely to have a direct effect on *Phymatolithon calcareum* but the consequences of a reduction in water flow rate may. Reduced water flow would allow greater build up of deposited particulate matter effectively covering the algae and restricting photosynthesis. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Phymatolithon calcareum* means that vegetative regeneration will take a long time.
Emergence regime changes - local	Maerl species have a very poor ability to tolerate emersion - only a few minutes exposure to the air would be sufficient to cause death. Sexual reproduction is virtually unknown in British Isles populations. Once a population has become extinct, the lack of propagules means that it is unlikely that it will be re-established. Even if reproductive propagules arrive from elsewhere, with the very slow growth rate of *Phymatolithon calcareum*, it will take a very long time to re-establish a similar population.
Wave exposure changes - local	Maerl is restricted to less wave exposed areas. Strong wave action can break up the nodules into smaller pieces and scatter them from the maerl bed. *Phymatolithon calcareum* is more tolerant of high wave exposure than *Lithothamnion corallioides.* Wave action during storms can be very important in determining the loss rates of thalli from maerl beds. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Phymatolithon calcareum* means that vegetative regeneration will take a long time.

Water clarity changes	The low water clarity of coastal waters (limiting photosynthesis) restricts the distribution of maerl in the British Isles to shallow waters - typically less than 10 metres. An increase in turbidity would further restrict the depth distribution of a population. A decrease in turbidity would benefit the population, facilitating photosynthesis. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Phymatolithon calcareum* means that vegetative regeneration will take a long time.
Nutrient enrichment	Cabioch (1969) suggested that maerl was tolerant to increases in nutrients. However, the growth of ephemeral algae may be increased, resulting in smothering of the maerl and restriction of photosynthesis. Following removal of the excessive ephemeral algae it should not take too long for the population to return to normal.
Removal of target species	Harvesting of maerl is one of the greatest threats. In England only dead maerl is extracted. However, even this can have detrimental effects, resuspending sediments that resettle and cover the algae reducing photosynthesis. In live beds the living nodules are typically on the surface so these are the first to be removed. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Phymatolithon calcareum* means that vegetative regeneration will take a long time.
Removal of non-target species	Maerl has no known obligate relationships. Extraction of other species will probably have no direct effects on *Phymatolithon calcareum*. Extraction of other organisms such as scallops using dredges can potentially cause great damage through physical disruption, crushing, burial and the loss of stabilising algae. These effects are addressed in the appropriate factors above. Propagation in the British Isles is almost entirely vegetative so recruitment of new individuals to the population will not aid recovery. The very slow growth rate of *Phymatolithon calcareum* means that vegetative regeneration will take a long time.

3.19	***Tenellia adspera***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local	*Tenellia adspersa* can live under a wide range of water temperatures since it occurs in lagoons which undergo great seasonal temperature variation and it occupies a wide geographic range, from the Lofoten Islands to the Mediterranean.
Salinity changes - local	The species can tolerate a wide range of salinities and will reproduce in salinities of 3 psu to 40 psu (Roginskaya, 1970).
Water flow (tidal current) changes - local	The species is normally found at sites of slow water current, but it has been observed to withstand rapid water flow (0.8-2.4m/sec.) as evidenced by animals occupying the lattices of pipe lines.
Emergence regime changes - local	The low shore position and soft-bodied nature of this species suggests that it is unlikely to tolerate emersion as it would suffer desiccation. Where the species is exposed to emersion, individuals are likely to be present deeper at the site, so providing a source for recolonization. Where unaffected individuals are not present recovery would be low due to the species limited distribution.
Wave exposure changes - local	The species is largely known from wave sheltered locations, which suggests an inability to tolerate exposed conditions. Recovery would be low due to the limited distribution of the species.
Water clarity changes	Neither the species or the hydroids on which it lives are dependant on light availability, so it would not be affected by a change in turbidity.
Habitat structure changes - removal of substratum (extraction)	The species lives on hydroids attached to rocks, algae or artificial substrates. The loss of the substrate would cause removal of the species and recovery would be very low due to the limited distribution of the host species.
Heavy abrasion, primarily at the seabed surface	The species occurs in the surface hydroid turf and it is soft-bodied so would be easily damaged upon impact. In addition, a passing dredge is likely to damage its substratum (see substratum loss above). Therefore, an intolerance of high has been recorded.
Light abrasion at the surface only	
Siltation rate changes	The hydroids on which *Tenellia adspersa* lives may be killed by smothering, so removing the species food source. Recovery would be low due to the limited distribution of the *Tenellia adspersa*.
	The species is probably able to tolerate siltation as it occurs in estuaries and lagoons where siltation naturally occurs. Recovery from any damage could be rapid due to the fast growth and reproductive rates of the species.
Introduction or spread of non-indigenous species	Insufficient information
Introduction of	Insufficient information

microbial pathogens	
Removal of target species	Insufficient information
Removal of non-target species	Insufficient information

3.20	***Victorella pavida***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local increase	The growth rate of *Victorella pavida* increases with temperature. During laboratory culture, a two-fold increase in growth rate was observed in colonies initially cultured at 15°C followed by 19°C (Carter, 2004). Jebram (1987) was able to culture *Victorella pavida* at 20 to 22°C. In the Cochin Waters of India, *Victorella pavida* can survive monsoon and post-monsoon conditions and was recorded as occurring commonly during the post-monsoon season and surviving temperatures of around 30°C (Menon & Nair, 1971). The growth cycle of *Victorella pavida* is seasonal and therefore temperature dependent. In the winter, colonies are dormant in the form of hibernacula; when temperatures reach 13°C, the hibernaculum will germinate giving rise to a new colony (Carter, 2004). It would be intuitive to suggest that a permanent/semi-permanent increase in temperature above 13°C would be conducive to the existence of a permanently active population. Menon & Nair (1967) examined the abundance of *Victorella pavida* in Cochin Waters. The temperature over a year ranged from 21.1 to 32.4°C, however, the abundance of *Victorella pavida* appeared to be influenced by the monsoon and hence salinity fluctuations; colonies were abundant during the monsoon and post-monsoon periods, which coincides with a low salinity but absent during pre- monsoon periods when a full salinity was recorded, therefore, a complete absence during pre-monsoon periods is due to salinity and not temperature (Menon & Nair, 1967). *Victorella pavida* appears tolerant of increases in temperature and no data exists to suggest that acute temperature change is detrimental. Recoverability is recorded as high.
Temperature changes - local decrease	In Swanpool, colonies of *Victorella pavida* die-off when exposed to temperatures below 12°C (Carter, 2004). However, this species produces resting stages called hibernacula that enable colonies to remain dormant for the duration of the winter (Ryland, 1970; Bushnell & Rao, 1974; Silen, 1977; Evans *et al*., 2003). Therefore, whilst this species may be tolerant of low temperatures an ability to recover from a period of cold would depend on the length of time in dormancy and whether favourable temperatures resume to allow for germination. Therefore recoverability is recorded as moderate.
Salinity changes - local increase	*Victorella pavida* is considered to be a euryhaline species (Ryland, 1970). The salinity in Swanpool is highly variable, ranging from zero to 22 psu (Evans *et al*., 2003). Recent experiments on hibernacula germination found that germination will occur quite readily in 3.5 and 18 psu (68 and 69% respectively) but is severely retarded in 36 psu (20%). However, after a month exposed to the three salinities, extensive colony growth occurred in 18 psu and also in the 36 psu whilst zooids exposed to 3.5 psu all died (Carter, 2004). Whilst hibernacula germination is severely retarded in 36 psu, subsequent colony growth is quite extensive and therefore zooids are very tolerant of full salinity.

Salinity changes - local decrease	In Swanpool, colonies of *Victorella pavida* are 30% less abundant at the freshwater stream inlet than other sites around the lagoon (Carter, 2004). This decrease in abundance may be due to the periodic low salinity in that area as a result of increased freshwater input from heavy rainfall. Experiments on the germination of hibernacula (see above) found that zooids of *Victorella pavida* are highly intolerant of low salinities (<3.5 psu) for extended periods. Whilst hibernacula will germinate readily in 3.5 psu, colony growth did not extend beyond the primary zooid and after 20 days, all zooids had died (Carter, 2004). Further experimentation found 5 psu to be lethal also, and the optimum salinity for germination and growth appeared to be 13 psu (Carter, 2004). On this basis, intolerance to decreased salinity is low and also recoverability would be high.
Water flow (tidal current) changes - local increase	The major source of water flow arises from the freshwater stream inlet. The flow rate at the inlet is low in the summer reaching a peak of 200 $m^3.h^{-1}$ in November (Evans *et al*., 2003). Evans *et al*. (2003) found a significant positive correlation between flow rate and cumulative rainfall over 28 days. An increase in flow rate would disturb the sediment and increase the amount of suspended silt and particles, which may have deleterious consequences for feeding and growth (see suspended sediment above). The abundance of *Victorella pavida* is 30% less at the freshwater inlet site compared with the rest of the lagoon, any effect of increased flow rate and/ or increased silt as a result of heavy rain, would be compounded by decreases in salinity (Carter, 2004). The incursion of seawater into the lagoon, via a culvert, tends to occur at very high tides (i.e. tides of a height >+5.64 m CD) (Evans *et al*., 2003). The inflow of seawater into the lagoon has been recorded to be between 1100-3500 m^3 (Dorey *et al*., 1973). Gainey (1997) recorded the abundance of the trembling sea mat as common to frequent around the culvert. Intolerance is recorded as intermediate, due to the dynamics of the lagoon extensive fluctuations in flow rate do not effect the whole lagoon. Recoverability is therefore recorded as high.
Water flow (tidal current) changes - local decrease	A degree of water flow is required for transportation of food particles. However, due to the dynamic nature of the lagoon (see above) the water in the lagoon is rarely stagnant for extended periods. Bryozoans have tiny hairs, or cilia, on each tentacle which beat and create a localised current around the colony (Ryland, 1970). This action provides a current to draw food towards the mouth. On this basis, tolerant has been recorded.
Emergence regime changes - local increase	Increased emergence will expose populations to increased risk of desiccation (see above), increased extremes of temperature, and decreased length of time for feeding. Hence, a high intolerance of increased emergence has been recorded. During unfavourable conditions, *Victorella pavida* has the potential to regress into dormancy by producing resting buds called hibernacula, and re-emerge during favourable conditions. On this basis, recoverability is recorded as moderate and dependent on the length of emergence as hibernacula are short-term resting bodies and can potentially lose 50% viability in five months).
Emergence regime changes - local decrease	A decrease in emersion will decrease the risk of desiccation and effectively provide additional substrata for colonization, potentially allowing the *Victorella pavida* population to increase. Therefore, tolerant* has been recorded.
Wave exposure changes - local increase	Swanpool is considered as an extremely sheltered site and the movement of water as a result of high winds would be negligible. An increase in exposure, and therefore wind/wave exposure, as a result of habitat degradation is also unlikely due to the protected status of the reed bed and lagoon.

Wave exposure changes - local decrease	A decrease in wave exposure would have no impact on *Victorella pavida*. Swanpool lagoon is a very sheltered site and a further decrease in wave exposure is unlikely.
Water clarity increase	A decrease in turbidity is likely to increase primary productivity and food availability for *Victorella pavida* and is unlikely to be adversely effected by a decrease in turbidity, so tolerant has been recorded.
Water clarity decrease	An increase in turbidity is likely to result in a decrease in phytoplankton which may reduce food availability for *Victorella pavida*. Therefore an intolerance of low has been recorded.
Habitat structure changes - removal of substratum (extraction)	*Victorella pavida* requires hard substrata for larval settlement and growth and can grow on stones but has a particular predilection for *Phragmites australis*. Removal of any hard substrata could potentially remove a significant proportion of the Swanpool population permanently and is therefore considered highly intolerant of substratum loss. However, recoverability is considered moderate on the basis that it may be possible for residual hibernacula to germinate and any remaining colonies can potentially undergo clonal propagation. The possibility that *Phragmites australis* will be partially or fully removed is low due to the level of protection imposed on reedbed habitats (see IMU.NVC_S4) and Swanpool lagoon.
Heavy abrasion, primarily at the seabed surface	As a ctenostome bryozoan, the body wall of *Victorella pavida* is composed of a non-calcified, flexible cuticle (Hayward, 1985). The body wall is potentially easily penetrable and any contact with a firm object will have lethal consequences therefore an intolerance of intermediate has been recorded. Recoverability is likely to be high.
Light abrasion at the surface only	
Siltation rate changes	The ability of *Victorella pavida* to tolerate or recover from a smothering incident would be dependent on the nature and duration of smothering event. As an active suspension feeder this sea mat is dependent on the orifice of the zooid remaining clear in order to evert a ring of tentacles to feed. Culturing *Victorella pavida* in low salinities (e.g. <18 psu) can promote the growth of a gromiid freshwater amoeba of the genus *Lecythium*. This organism produces a matrix of branching pseudopodia that extends between and over the zooids rendering the zooids unable to evert their tentacles to feed. Eventually all colonies died (Carter, 2004). No evidence of such activity exists in the wild population. Therefore, intolerance to smothering is recorded as intermediate and recoverability as moderate.
	In the event of high siltation due to severe disturbance, particles of silt can attach to the feeding tentacles or block the orifice and prevent the eversion of the tentacles. The freshwater run-off was diverted into Swanpool, by South West Water, from a new housing development in 1983. Subsequent development around Swanpool increased the freshwater input with a concomitant decrease in salinity, which may have a detrimental effect on the population (Gainey, 1997), as the trembling sea mat is intolerant of low salinity (<3.5 psu) for lengthy periods (see Salinity below). After rain, the fresh water stream entering Swanpool lagoon is heavily laden with silt. Additional silt enters the lagoon as run-off from surrounding roads. Trembling sea mat populations are at risk from smothering in the long term as a result of increased siltation (Gainey, 1997). During a survey of the lagoon in 2003 it was confirmed that the greatest sedimentation occurred at the freshwater inlet

	site at 500-5000 g/m^2 (Evans *et al*., 2003). The authors indicated such levels of sedimentation appear to have no detrimental effect on the abundance of *Victorella pavida* at the freshwater inlet site. However, any possible adverse effect of sedimentation on abundance at the freshwater inlet site is compounded by a reduction in salinity. Overall, it appears that siltation alone would not have a detrimental effect at the benchmark level and, therefore, tolerant has been suggested.
	As an active suspension feeder this sea mat is dependent on the orifice of the zooid remaining clear in order to evert a ring of tentacles to feed. An increase in suspended sediment could potentially smother the colony rendering the zooids unable to evert their tentacles to feed. On this basis a decrease in suspended sediment would be beneficial to the growth colony. In addition, a reduction of particles is likely to encourage larval settlement and subsequent growth of the colony. Therefore, the trembling sea mat is considered tolerant.
Introduction of microbial pathogens	During culturing of wild populations of *Victorella pavida* at low salinities (3.5 and 5 psu), the colony can be overcome by a freshwater gromiid amoeba of the genus *Lecythium*. The *Lecythium* sp. produces branching pseudopodia that extend between and over the zooids to the extent that the zooids are unable to evert their tentacles to feed and subsequently died (Carter, 2004). However, there is no information available on the impact of microbes on wild populations of *Victorella pavida*.
Removal of target species	As a protected species, *Victorella pavida* is unlikely to be removed to the extent of the benchmark level.
Removal of non-target species	*Victorella pavida* is commonly found growing on *Phragmites australis*, which extends around the periphery of Swanpool. Complete removal of this habitat would effectively be a removal of approximately 70% of available substrata for *Victorella pavida*, this would certainly have deleterious consequences for the population. Therefore intolerance of extraction is high and recoverability is low. However, extraction of this reedbed is unlikely to occur due to the protected status of the lagoon (County Wildlife Site, SSSI, and Local Nature Reserve).

3.21	***Atrina pectinata***
Pressure	**Evidence/Justification (e.g. supporting references, info on resistance resilience etc from MarLIN**
Temperature changes - local	Sub-tidal species such as *Atrina pectinata* are likely to exhibit lower temperature tolerance than intertidal species. They are likely to be intolerant of rapid temperature change indicated in this benchmark. However, no information on temperature tolerance in *Atrina pectinata* was found, although it has been suggested that changes in seawater temperature are likely to affect larval recruitment pattern (Anon., 1999c). A tropical pen shell *Atrina maura* was found to reach maturity more quickly at higher temperatures; taking only one month (normal maturation at lower temperatures of 20°C takes two months). However with higher temperatures, oocytes are of poor quality than at cooler temperatures (Rodriguez-Jaramillo, 2001). Intolerance of *Atrina pectinata* to temperature changes has been assessed as intermediate. Recovery is likely to be low (see additional information) therefore sensitivity is assessed as high.
Salinity changes - local	*Atrina pectinata* occurs subtidally at full salinity, however the infralittoral populations may experience variable salinity. Dan Minchin (pers. comm.) has suggested that *Atrina pectinata* may be exposed to reduced or variable salinities for brief periods. It is likely, however, that this species would be intolerant of reduced salinity. A tropical pen shell *Atrina maura*, had been found to have a wide range of halotolerance, from 16-50 (Leyva-Valencia *et al.*, 2001). Insufficient information was found to make an assessment.
Water flow (tidal current) changes - local	The species is known from weak to moderately strong currents, for example in Knightstown, Valentia Island the population is exposed to >2 knots on spring tides (Dan Minchin pers. comm.). Increased water flow could partly uncover adults and is likely to remove some individuals from the substratum, which would not then be able to survive to re-establish themselves. Changes in current patterns are also likely to affect larval recruitment (Anon., 1999c). Therefore intolerance of this species to an increase in water flow has been assessed as intermediate. Recovery is likely to be low (see additional information), therefore sensitivity is assessed as high.
Emergence regime changes - local	*Atrina pectinata* is subtidal or only exposed at extreme low water and is unlikely to experience emersion.
Wave exposure changes - local	*Atrina fragilis* (now *Atrina pectinata*) occurs in sheltered or very sheltered waters (Anon 1999c; Butler *et al.* 1993) and can burrow into the substratum if partly uncovered by wave action or storms (Yonge 1953). Increased water flow could partly uncover adults and is likely to remove some individuals from the substratum, which would not then be able to survive to re-establish themselves. Juveniles may be removed from sediment more easily than adults. Therefore intolerance of this species to an increase in wave action has been assessed as intermediate. Recovery is likely to be low (see additional information) therefore sensitivity is assessed as high.

Water clarity changes	It has been suggested that changes in turbidity may affect *Atrina pectinata* (Anon, 1999c). Pinnids are adapted to a sedimentary lifestyle and possess a unique ciliated waste canal for the removal of sediment from the mantle cavity (Yonge 1953). However, increased siltation will place an increased metabolic demand on filtration and a likely decrease in growth and reproductive capacity. Thrush *et al.* (1999) demonstrated a decrease in the biochemical condition in *Atrina zealandica* with increasing sediment load in the Mahurangi Estuary, New Zealand. *Pinna bicolor* and *Pinna nobilis* occur in sheltered areas of low turbidity. However, juveniles settle in the boundary layer and grow rapidly to escape the high levels of sediment and it is likely that Pinnids are tolerant of suspended sediment. The absence of *Pinna* sp. from areas of severe sediment disturbance (Bulter *et al.*, 1993) suggests that the populations in areas of high sediment availability will be adversely affected by increased siltation. Reduction in light intensity is likely to reduce phytoplankton productivity; however, it is also likely that Pinnids feed on detritus and other suspended organic matter. Therefore intolerance has been assessed as low. Recovery on return to normal conditions is likely to be immediate. Therefore this species has been deemed not sensitive to this factor.
	Atrina fragilis (now *Atrina pectinata*) cannot burrow upwards through sediment (Yonge 1953). However 1/3 to 1/2 of the animal can protrude above the surface which, in adults, can be up to 10 - 15 cm above the sediment surface. Therefore adult specimens may not be affected by this factor at the benchmark level. However small or juvenile specimens may be smothered. Pinnids are adapted to a sedimentary life style and exhibit a powerful exhalent current and a unique ciliated waste canal to remove sediment from the mantle cavity, as would be expected from occasional smothering due to storms (Yonge 1953). Clearance of sediment from the mantle constitutes a metabolic cost that may reduce the reproductive ability (Butler <i> et al</i>. 1993). However, adults are likely to cleanse themselves relatively quickly. Due to the likely lethal effects of this factor on juveniles, *Atrina pectinata* has been assessed as intermediately intolerant of this factor. Recovery is likely to be low (see additional information), hence sensitivity has been assessed as high.
Siltation rate changes	Pinnids are adapted to a sedimentary lifestyle and possess a unique ciliated waste canal for the removal of sediment from the mantle cavity (Yonge 1953). However, increased siltation will require increased metabolic demand on filtration and a likely decrease in growth and reproductive capacity. Thrush *et al.* (1999) demonstrated a decrease in the biochemical condition in *Atrina zealandica* with increasing sediment load in the Mahurangi Estuary, New Zealand. Along an increasing suspended sediment gradient, long term negative effects on the biomass and growth of *Atrina zelandica* were observed (Ellis *et al.*, 2002). Negative effects on condition of *Atrina zelandica* became apparent after only 3 days of exposure to increased suspended sediment levels, and clearance rates increased with increasing sediment loading, up to a threshold level, above which clearance rates decrease rapidly. Clearance rates of suspended sediment were lower at higher sediment concentrations (Ellis *et al.*, 2002). It may be that *Atrina zelandica* found in areas with naturally high sediment loading are adapted to cope better with increases in suspended sediment than those from areas with lower background sediment concentrations. None the less, very large increases in suspended sediment are still likely to be detrimental to *Atrina zelandica* (Hewitt & Pilditch, 2004). *Pinna bicolor* and *Pinna nobilis* occur in sheltered areas of low turbidity. However, juveniles settle in the boundary layer and grow rapidly to escape the high levels of sediment and it is likely that Pinnids are tolerant of suspended sediment. The absence of *Pinna* sp. from areas of severe sediment disturbance (Bulter *et al.* 1993) suggests that the populations in areas of high

	sediment availability will be adversely affected by increased siltation. Because adults are likely to cleanse themselves relatively quickly, intolerance of *Atrina pectinata* to this factor has been assessed as low. Recovery is likely to be very high, hence an overall sensitivity assessment of very low.
Introduction or spread of non-indigenous species	*Crepidula* sp. may have had some impact on near shore populations of *Atrina fragilis* on the south coast of England (Dan Minchin pers comm.).
Introduction of microbial pathogens	The *Pinnids* are parasitized by the Pea crab (*Pinnotheridae*) (Yonge 1953). Butler *et al.* (1993) state that *Pinna bicolor* and *Pinna nobilis* harbour macroscopic commensals or parasites of unknown effect, although an unidentified parasitic microbe has been recorded as causing castration of *Pinna nobilis*. Intolerance is therefore assessed as low, recovery very high, and sensitivity low.
Removal of target species	In Spain, pinnids may be collected for consumption, used as bait, or for use as souvenirs. In the Bay of Naples the byssus threads were historically used for making glues. In the Pacific, declines in production have occurred as a result of exploitation in other species of penshell (Cardoza-Velasco & Maeda-Martinez, 1997) Populations in the UK are too sparse to sustain any harvesting, and are protected by a Biodiversity Action Plan and under the Wildlife & Countryside Act 1981. Based on the UK population size, intolerance has been assessed as high. Due to predicted slow growth and poor fertilisation/recruitment, recovery has been assessed as low, providing a high sensitivity assessment.
Removal of non-target species	In the UK *Atrina pectinata* was more common in scallop beds in the early 1900s then at present. Presumably trawling and dredging of theses formerly populated regions is the reason for the decline of this species (Minchin pers. comm.). Dredging of a *Pecten maximus* bed off Glengad Head, Ireland, after 1975, removed many live specimens of *Atrina pectinata* in scallop dredges and the population of fan mussels is thought to have been destroyed by subsequent dredging (Anon 1999c). In the Adriatic queen scallop (*Aequipecten opercularis*) trawl fishery, *Atrina fragilis* (now *Atrina pectinata*) incurred more damage as a result of the fishing and sorting process than any other species of bycatch (Pranovi *et al.*, 2001). Rapido trawling (a form of beam trawl) for scallops in the Gulf of Venice resulted in the removal of organisms from the top 2 cm of sediment and an 87% reduction in *Atrina pectinata* (as *Atrina fragilis*) abundance in the trawl tracks. Some specimens were speared on the trawl teeth and pulled from the sediment (Hall-Spencer *et al.* 1999). Once removed from the sediment adults cannot dig themselves back into the sediment although they can burrow once vertical (Yonge 1953). Anon (1999c) reports the destruction of a population of *Atrina pectinata* (referred to in this study as *Atrina fragilis*) off Glengad Head, Ireland, by scallop dredging after 1975. Pinnids in the Mediterranean are associated with seagrass beds, the removal of which has been linked to the decline in Pinnid populations (Richardson *et al*., 1999). However, *Atrina pectinata* bed communities are little studied in the UK.