# MONITORING PLAN

## For the Câr-Y-Môr Carn Ar Wig & Porthlysgi IMTA Sites


### Abstract

Monitoring plan designed to build on environmental baseline set in Benthic Report submitted during application process to continue monitoring at the Carn Ar Wig & Porthlysgi IMTA farms operated by Câr-Y-Môr



Beth Marshall and Jon Moore

# 1. Introduction

## 1.1. Cât-Y-Môr

For the Love of the Sea Ltd is a Community Benefit Society trading as Cât-Y-Môr. The society was registered in Aug 2019. This society now has over seven hundred committed members. The Society is managed by 700+ individuals, with combined experience in aquaculture and fisheries, marine conservation, community engagement, business development and management skills. Cât-Y-Môr also purchased Solva Seafoods in 2020 to create local jobs and develop a trading record. In 2023 the businesses were fully merged and it has acted as a route to sell seaweed and shellfish grown on the farms.

Cât-y-Môr has started Wales's first regenerative ocean farm. Cât-y-Môr is located in the St Davids Peninsula, with a 3ha ocean farm near St Justinians growing kelp and other algae which settles on the farm structures. The current two trial sites at Carn ar Wig and Porthlysgi grow mussels, native oysters, and scallops. This farming method uses no fertiliser, pesticides or freshwater, and provides a sustainable nutritious food source. Cât-Y-Môr's long term goal is to continue ocean farming alongside the development of an education program and seaweed/ seafood processing facility. Ultimately, Cât-y-Môr hopes to inspire others to replicate this ocean farming method across Wales. Regenerative ocean farms across Wales will enhance local marine biodiversity and the well-being of local communities, stimulate sustainable ocean jobs creation and give young people a route into an integrated Welsh seafood sector.

## 1.2.Carn Ar Wig IMTA

The two hectare site (labelled Carn Ar Wig) is 500 meters south west of the St Justinians IMTA site. The marine environment in this location is highly suitable for ocean farming. This conclusion is based on the successful tests at the trial farms (PEBL, 2022), and accessibility to the site. The site is located in Ramsey Sound in a shallow open bay on the east side of the Sound (*Figure 1)*. The minimum depth is 10m at chart datum. The surrounding sea is 32 - 35 ppt salinity, with high tidal currents, delivering massive quantities of nutrient rich water to the farmed species . The water quality is classed as 'A Grade' (CEFAS, 2024) with no local significant freshwater input.


*Figure 1: Location of the Carn Ar Wig IMTA site*

Infrastructure on the seabed is 4 x 500kg anchors, 1 x 85m length and 1 x 40m length of 30mm ground chain, and assorted oyster cages. Other infrastructure includes lines seeded with seaweed, header lines with shellfish lantern nets, spat ropes and assorted buoys for supporting the farm structure. Anchors and ground chain will be installed May/June 2026. *Figure 2* gives an overview of infrastructure in the water. The farm management team visits the farm approximately three times per week. During the seaweed harvest period (May-June and August-September) farm visits are more frequent.

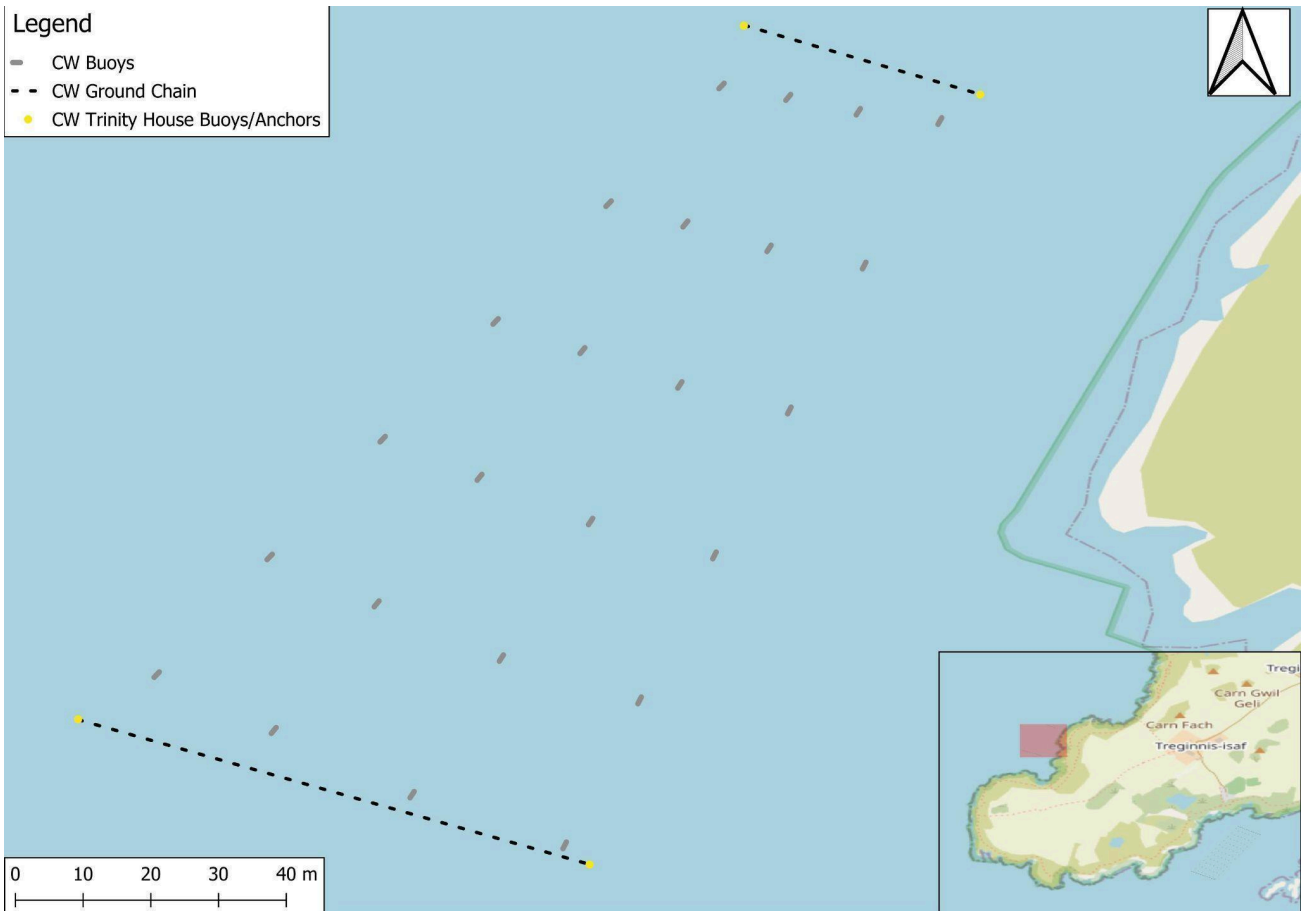


*Figure 2: Layout of the Carn Ar Wig IMTA site.*

## 1.3. Porthlysgi IMTA

The three hectare site (labelled Porthlysgi) is 600 meters south-west of Porthlysgi Bay. The marine environment in this location is highly suitable for ocean farming. This conclusion is based on the successful tests at the trial farms (PEBL, 2022), and accessibility to the site. The site is located just around the headland from Carn Ar Wig outside Ramsey Sound in the North East corner of the wider Porthlysgi Bay area (*Figure 3)*. The minimum depth is 10m at chart datum. The surrounding sea is 32 - 35 ppt salinity, with fewer tidal currents than Carn Ar Wig due to being in a bay, however the bay is open to the ocean on the south which allows waves and currents to deliver massive quantities of nutrient rich water to the farmed species. The water quality is classed as 'A Grade' (CEFAS, 2024) with no local significant freshwater input.


*Figure 3: Location of the Porthlysgi IMTA site*

Infrastructure on the seabed is 4 x 500kg anchors, 2 x 110m lengths of 30mm ground chain, and assorted oyster cages. Other infrastructure includes lines seeded with seaweed, header lines with shellfish lantern nets, spat ropes and assorted buoys for supporting the farm structure. Anchors and ground chain will be installed May/June 2026. *Figure 4* gives an overview of infrastructure in the water. The farm management team visits the farm approximately three times per week. During the seaweed harvest period (May-June and August-September) farm visits are more frequent.

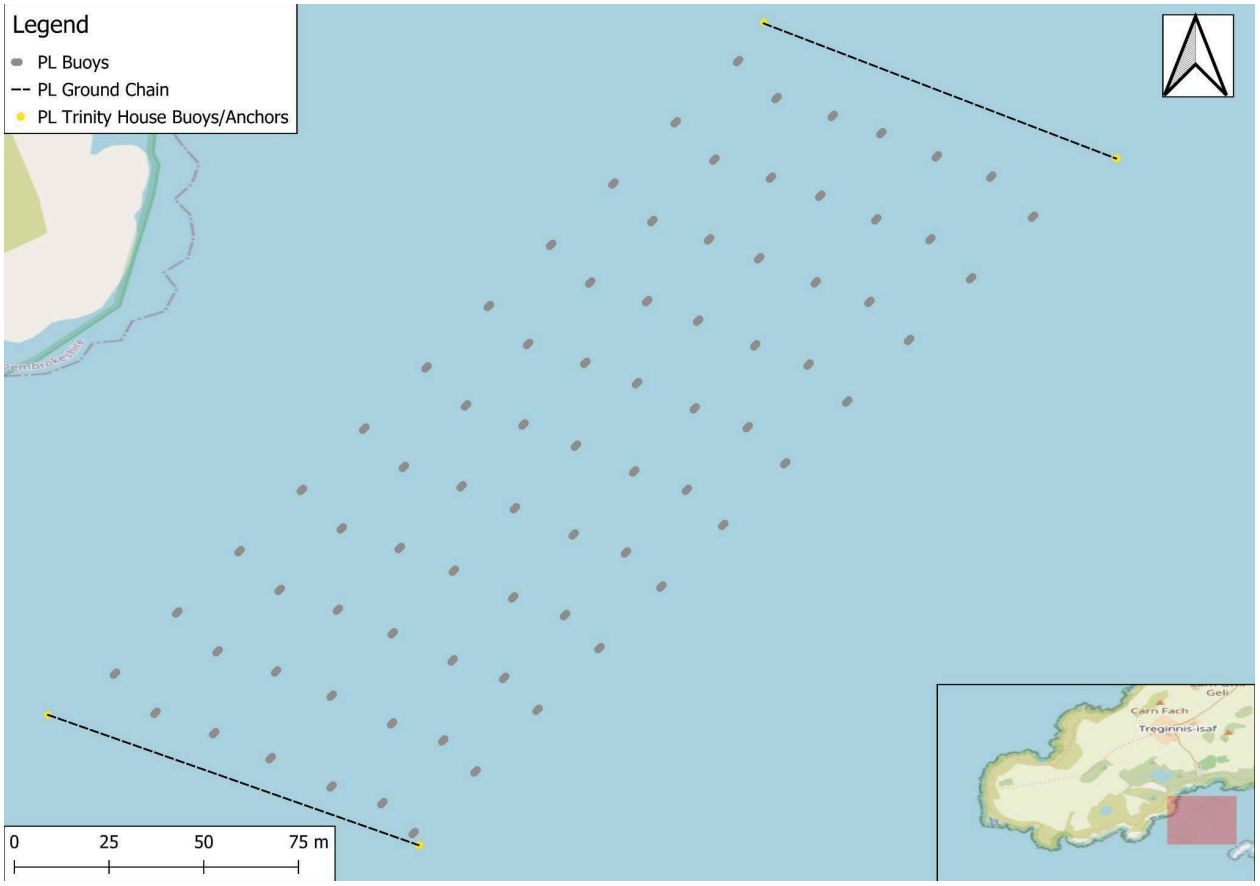


*Figure 4: Layout of the Porthlysgi IMTA site.*

## 1.4. **Pembrokeshire Marine SAC**

Ramsey Sound lies within the Pembrokeshire Marine Special Area of Conservation, which is protected under the Conservation of Habitats and Species Regulations 2017 (as amended). The site has been designated for a number of habitats and species, but the focus of this monitoring plan is primarily on just one of those features: *Reef* habitat (NRW)**.**

NRW (2018) summarises the conservation objectives for reef habitat in the SAC. They are that: i) the distribution and extent of reef within the site is stable; ii) the physical, biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded; and iii) the presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded (NRW).

## 1.5. NRW licence

### 1.5.1. DEML2540 Decision Document

#### *1.5.1.1. Benthic Ecology*

*Public Representation were received raising concerns surrounding the potential impacts of the works on benthic habitats.*

*The works lie within the Pembrokeshire Marine SAC. DEML2540 Baseline Benthic Habitat Survey Report dated 20 June 2025 was submitted with the application. The survey concluded that the Car y Wig site was a mixture of boulders and sediment habitat, while the Porthlysgi site was predominantly sandy sediment with areas of bedrock and boulders.*

*As detailed within the Applicants DEML2540 Environment Information to inform HRA submitted 05 September 2025 the Applicant has committed to the use of drop-down video to help microsite the location of anchors and chains avoiding sensitive habitats. The Applicant has also committed within the DEML2540 Baseline Benthic Habitat Survey Report to monitor areas of the farm for effects of infrastructure such as chains and cages on the seabed.*

*NRW A in representation dated 3 October 2025 noted that impact of the proposals include build-up of sediment, modification of habitat and potential scour resulting from farm infrastructure. Due to location of the works within the Pembrokeshire Marine SAC and potential impacts on its features, specifically Large Shallow Inlets and Bays and Reef features, NRW A welcomed the Applicants commitments to regular monitoring however considered further detail was required surrounding potential trigger points at which intervention will be initiated. The applicant in DEML2540 Further Information Request Response dated 11 December 2025, confirmed its commitment to include the proposed Carn ar Wig and Porthlysgi sites within its annual monitoring programme and to work with NRW A to agree clear trigger points.*

*NRW MLT consider that there remains uncertainty surrounding potential impact of the works surrounding features of the Pembrokeshire Marine SAC, however that a programme of monitoring and regular reporting can be conditioned as part of the Marine Licence and action taken should potential impact be identified (see Annex 1 condition 3.23). NRW MLT has sought timing of reporting to coincide with reporting requirements of the applicants Marine Licence DEML2151 for the Cârr-Y-Môr site. NRW MLT welcome the Applicants commitment to use drop-down video to support the micro-siting of anchors and chains avoiding sensitive habitats. NRW MLT consider that this should be incorporated into the Environment Management Plan (see Annex 1 Condition 3.22).*

### 1.5.2. DEML2540 Marine License

***3.23 Monitoring***

*3.23.1 The Licence Holder must submit a Monitoring Plan to the Licensing Authority for written approval at least 6 weeks prior to commencement of the Licensed Activities. No Licensed Activities may be undertaken prior to written approval from the Licensing Authority.*

*3.23.2 The Licence Holder must ensure that any actions outlined in the Monitoring Plan detailed in Condition 3.23.1 are implemented as approved in writing by the Licensing Authority. Any proposed changes to the Monitoring Programme must be submitted to, and approved in writing by the Licensing Authority prior to any changes being enacted.*

*3.23.3 The Licence Holder must submit its first report to the Licensing Authority before the 31 March 2027. Thereafter subsequent reports shall be submitted to the Licensing Authority every year unless otherwise approved by the Licensing Authority.*

*3.24 Decommissioning*

*3.24.1 The Licence Holder must ensure that all infrastructure and associated*

*equipment are decommissioned prior to 10 April 2046, or within 2 months*

*from the cessation of operations, whichever is the sooner.*

## 2. **Reef**

Reef, in the context of SACs and the Habitats Directive, is defined by the European Commission (European Commission, 2013) as:

> *"either biogenic concretions or of geogenic origin. They are hard compact substrata on solid and soft bottoms, which arise from the sea floor in the sublittoral and littoral zone. Reefs may support a zonation of benthic communities of algae and animal species as well as concretions and corallogenic concretions."*

Irving (2009) provides additional useful guidance on the patchiness of 'stony reef':

> *The minimum size of a reef has been agreed as being >25m$^2$ and it must consist of >10% cobbles (or larger particles, ie [boulders & bedrock]). The critical part appears to be the amount/extent of sediment forming the matrix within which the cobbles (clast material) are found. The greater the sediment component then the more patchy the stony reef feature is likely to be and consequently of lower 'reefiness'.* (Irving, 2009)

This is relevant to the reef at Carn Ar Wig, which is very patchy and composed of bedrock, boulders and cobbles with finer sediments between. The extent and distribution of reef at Carn Ar Wig has been mapped during the Baseline Benthic Habitat Survey Report v5 submitted as part of the application process for DEML2540 and shows the habitats under the proposed farm are much the same as previously recorded under the current farm: *The use of video footage has allowed for much more detailed designations of seabed habitats than the predicted maps allow. The current farm at Carn Ar Wig has a mixture of Sublittoral Mixed Sediment (SS.SMx) and Moderate Energy Circalittoral Rock (CR.MCR). Most of the farm is covered with sediments of various types with a substantial covering of green and red seaweeds and clusters of small to medium sized boulders which are dispersed across the farm area. The boulders show more red and green seaweeds growing on them with a few orange sponges being seen in the footage between the south west and north east anchors. Due to the presence of these boulders the area has been designated as circalittoral rock, although there are still plenty of areas of sediment. The video footage of the southern anchors shows these are placed in areas of mixed sediment and not placed on the boulders, however the footage for the northern anchors shows some SS.SMx but also CR.MCR, particularly for the North East anchor. The proposed farm area for Carn Ar Wig is a mixture of the same habitats as the current area, with*

*the CR.MCR giving way to SS.SMx along the North and West areas of the farm. This would be expected as the coastline is along the South and East edges of the farm and therefore rocky habitats would be more likely to occur here. To ensure the anchors are being placed in the areas of sediment described above, the anchors will be micro-sited by confirming the area of deployment and then using drop down video to ensure these areas are acceptable. The diver footage showed an area of CR.MCR over the proposed South West anchor which would need to be avoided. To avoid the areas containing most boulders, the oyster cages will be deployed within the northern end of the farm and further west to stay within areas of mixed sediment.*

Surveying of Porthlysgi was reported as follows: *The proposed farm at Porthlysgi is covered by a variety of habitat types. The western and northern edges of the farm are fringed by cliffs which give way to rocky areas in the subtidal zone. The ROV survey characterised these areas as Bedrock with Kelp Park (IR.MIR.KR.Lhyp.Pk) and Scoured Rocks and Sand (IR.HIR.KSed.XKScrR). The Scoured Rocks and Sand habitat also extends slightly into the south-western corner of the farm before giving way to Rippled Fine Sand (S.SSa.IMuSa), which covers the main area of the proposed farm area. Towards the northern edge of the farm there is also a mixture of areas of Silty Fine Sand (SS.SSa.IMuSa) and Mobile Coarse Sediment Waves (SS.SCS.CCS). The ROV report describes Infralittoral bedrock, with kelp park and red algal turf as silty bedrock ridges with kelp park and red algal turf at a depth of 6.5m to 9.5m with conspicuous fauna sparse, except for occasional boring sponges (Cliona celata) and cup corals (Caryophyllia smithii). Red algal turf included Heterosiphonia plumosa, Calliblepharis ciliata, Delesseria sanguinea and other foliose species. Coarse sand, pebbles and cobbles covered the floor of troughs between ridges. Kelp on the tops of ridges included Laminaria hyperborea, Saccharina latissima & Saccorhiza polyschides. Some high ridges present, some with steep / vertical sides, with bryozoan turf. [Biotope code: IR.MIR.KR.Lhyp.Pk]. The ROV report describes Infralittoral boulders, cobbles and low lying bedrock strongly influenced by sand as where the bedrock meets the sand there are typically areas of mixed rock and sand habitat that can include fairly extensive areas of boulders and cobbles sticking out of the sand, approx. 10m. The rocks in these areas are, to a greater or lesser extent, scoured and smothered by sand, so that the assemblage of epibiota on the rocks is limited to a low diversity of species that are tolerant of such conditions. The most scoured rock surfaces are bare, while the least affected are colonised by a range of algae and animals similar to the kelp park habitat described above. Encrusting coralline algae and tubes of the keel worm Spirobranchus are particularly common. Other animals included occasional hermit crab Pagurus bernhardus and netted whelk Tritia reticulata. [Biotope code: IR.HIR.KSed.XKScrR]. The ROV Report describes Coarse sediment waves as an area of mobile sand, gravel, pebbles and cobbles, forming sand waves with very little conspicuous life, at 9.5m to 11.5m in the middle of the bay. Coarsest sediment (mainly gravel & pebbles) on tops of ridges. Finer sand, with some silt, in troughs. Occasional scallops on ridge tops. This habitat gradually merged into the rippled fine sand habitat, described previously. [Biotope code: SS.SCS.CCS]. The DDV footage of the proposed farm for Porthlysgi confirmed that the western and north western edges of the site would be placed on or near various rocky habitats and these would need to be avoided during deployment*.


*Figure 5: Rendering of the Carn Ar Wig farm site with an approximation of reef features taken from sonar surveys.*

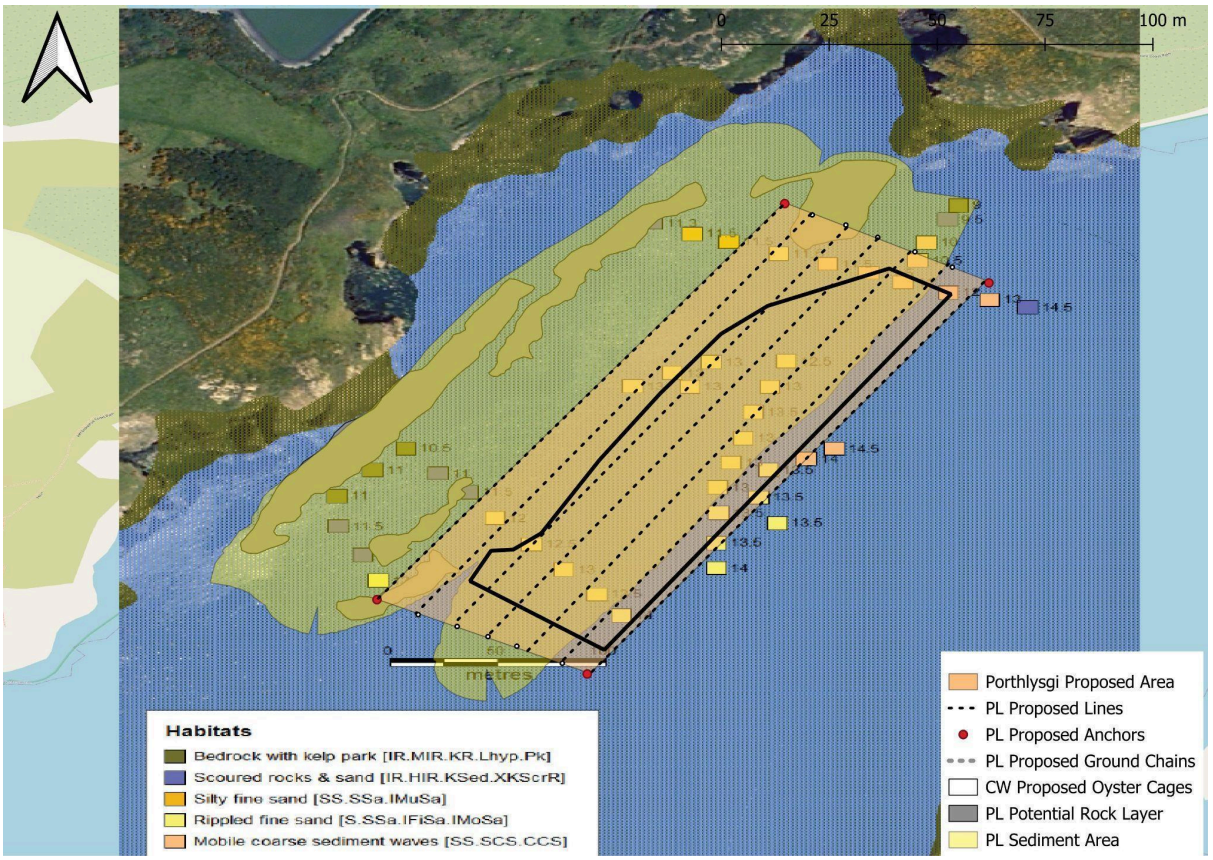


*Figure 6: Rendering of the Porthlysgi farm site with an approximation of reef features taken from sonar and ROV surveys.*

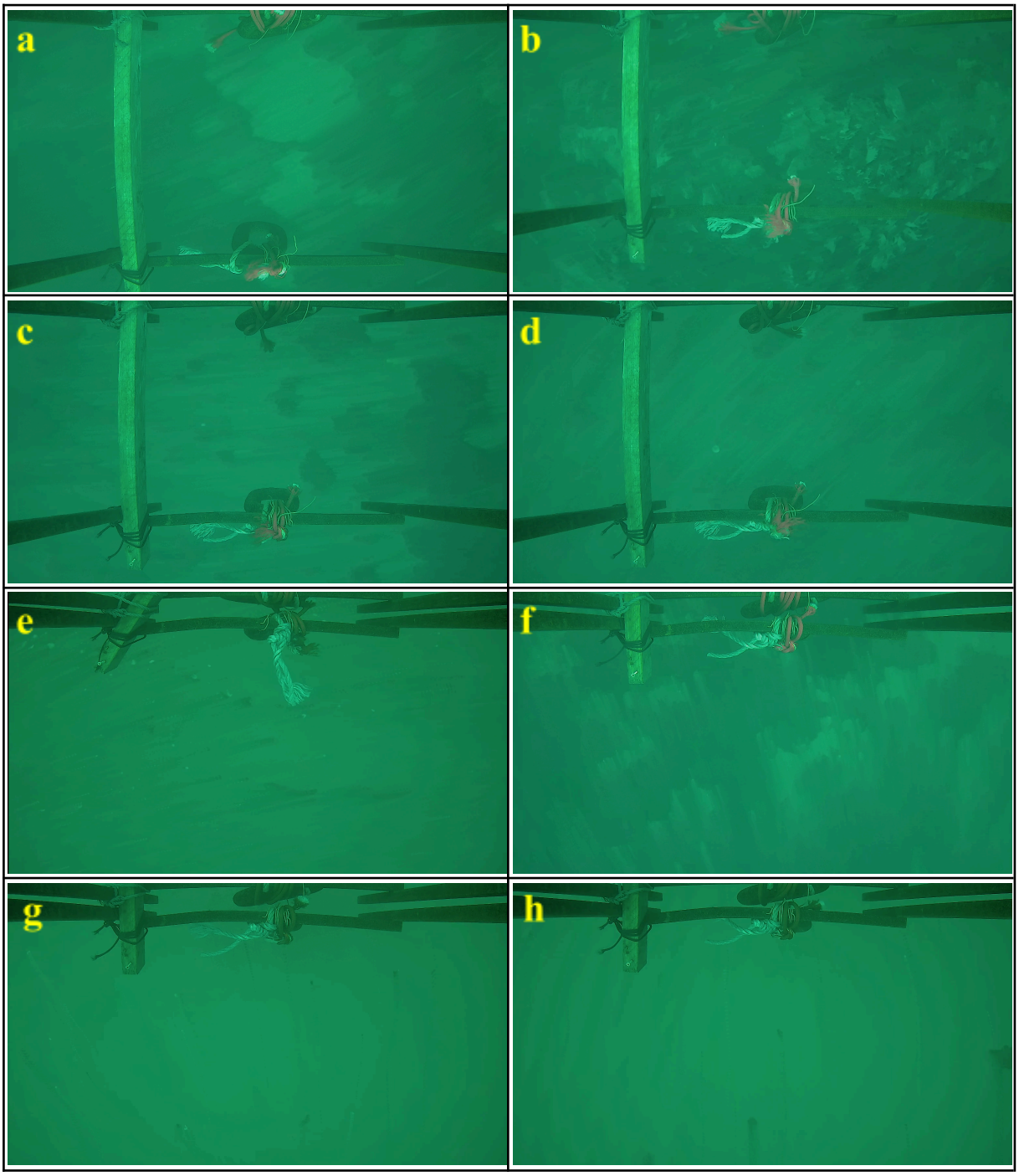


*Figure 7: Video stills (captured from DDV footage) to illustrate some of the range of reef and sediment habitats in the new farm locations at Carn Ar Wig (a-d) and Porthlysgi (e-h).*

## 2.1. **Risks to subtidal reef habitat from IMTA farms**

Integrated multi-trophic aquaculture is a new industry and there has been very little study of its specific effects on the marine environment. However, the component features of an IMTA farms infrastructure and activities are not new and there is considerable literature (particularly regarding ocean going vessels) and experience to inform an assessment (Broad, Rees, & Davis , 2020).

However, data is significantly lacking on the impacts of static mooring systems on subtidal reefs. It is our hope that the data collected from this monitoring plan will begin to fill knowledge gaps around static macroalgae aquaculture mooring systems and their impacts on temperate rocky reefs in Wales.

The potential known effects can be summarised as follows:

1) Direct effect of the farm infrastructure:
   a) Loss of habitat (permanent or temporary) from the footprint of the farm mooring infrastructure (i.e. anchors & chains);
   b) Physical damage from anchors, chains and other infrastructure (e.g. seabed cages) during installation or post-installation movement (e.g. from storm damage);
2) Indirect effects of the farm presence & operation
   a) Smothering by materials that may drop to seabed and accumulate during operation of the farm (e.g. seaweed detritus and shellfish shells). This impact is unlikely at this specific site due to the high energy environment of Ramsey Sound and the relatively small scale aquaculture operation (Visch, Kononets, Hall, Nylund, & Pavia, 2020) (Campbell, et al., 2019) (Chamberlain, Fernandes, Read, Nickell, & Davies, 2001) (Weitzman, Steeves, Bradford, & Filgueira, 2019) (Wood , Capuzzo, Kirby, Mooney-McAuly, & Kerrison, 2017);
   b) Shading seabed from sunlight. This is relatively insignificant based on local site monitoring and data from studies of other sites (Campbell, et al., 2019) (Weitzman, Steeves, Bradford, & Filgueira, 2019) (PEBL, 2022) (Wood , Capuzzo, Kirby, Mooney-McAuly, & Kerrison, 2017).
   c) Changes in hydrodynamic regime (tidal currents and wave exposure). However, date from monitoring on the site shows that in this particular location this is not an issue. This is likely due to the high energy environment of Ramsey Sound and the relatively small scale nature of the seaweed/ shellfish farm (Weitzman, Steeves, Bradford, & Filgueira, 2019) (Wood , Capuzzo, Kirby, Mooney-McAuly, & Kerrison, 2017) (PEBL, 2022).

Relating those effects to the conservation objectives listed in Section 1.3:

i) reduced distribution and extent of reef could result from 1a) and 1b) if they cause permanent loss of habitat;
ii) degradation of the reef's structure and function could result from 1) and/or 2) if they cause ecologically significant changes for a substantial period of time;
iii) degradation of the reef's typical species could result from 1) and/or 2) if they cause significant changes to those species for a substantial period of time.

Monitoring objectives have not been defined so the overall aim of the survey and monitoring programme is to provide data that informs assessment against the conservation objectives. However, it is inevitable that assessment of ii) and iii) will be to some extent subjective, based on the collected data followed by expert judgement of their significance. The significance of any effect will embody the magnitude of change, the area affected (relative to the total reef area) and the period of the effect.

## 3. Rationale of survey and monitoring design

Baseline data on the habitat types at both Carn Ar Wig and Porthlysgi has been reported during the application process in the Baseline Benthic Habitat Survey Report. The St Justinian's site has a Monitoring Plan in place which was agreed during the application process for DEML2151 which includes ROV/DDV as well as diver surveys. However, the use of divers is costly and difficult to implement due to the conditions of the Ramsey Sound providing only limited suitability for divers to survey the infrastructure.

After consultation with the divers who would carry out these surveys, it was decided to omit the diving aspect of the surveying and instead focus on capturing good quality footage of the chains/anchors on the seabed by using ROV or DDV.

Of the potential effects listed in the section above, it is understood that NRW's primary concerns relevant to the Carn Ar Wig farm are from the first two on the list: 1a) loss of habitat and 1b) physical damage. Loss of, or damage to, poor quality sediment scoured reef habitat will be of less concern than loss of, or damage to, the more valuable habitats. Smothering is considered of limited risk in this area because of the relatively strong tidal currents; and a limited amount of light reaches the seabed anyway, due to depth and turbidity. Reduced light may have some effects on the abundance of some red algal populations, but this is not expected to have a significant effect on attributes related to the reefs function or its typical species. Previous monitoring of multiple sites has shown there is no significant difference in light regimes in the Ramsey Sound when a seaweed farm is in the water (PEBL, 2022). Changes to the hydrodynamic regime are considered unlikely at the scale of the Carn Ar Wig farm as the site is relatively small scale compared to the high energy environment of Ramsey Sound (Green Wave, 2024).

As Porthlysgi is mostly sand of a highly mobile nature, there is less of a concern that the seabed infrastructure would cause damage to any habitats here. However, the north-western edge of the farm is fringed by cliffs which give way to rocky areas in the subtidal zone and a previous ROV report from this area identified infralittoral bedrock with kelp park and red algal turf. Due to the high level of smothering and scouring of rock in this area by sand, the diversity of species in this area is low and generally limited to species which are tolerant of these conditions. The report also recorded occasional other species such as hermit crab (*Pagurus bernhardus*) and netted whelk (*Tritia reticulata*). Because of these factors, monitoring should also be carried out at this site.

The footprint of the chain and anchors of the current farms has already been described during the Baseline Benthic Habitat Survey Report and was found to be acceptable enough by NRW to grant the license as long as the monitoring conditions described above were met. When the chain and anchor are removed then the underlying reef habitat will recover naturally. Recovery time will depend on the pre-impact quality of the habitat; likely ranging from <1 year to >5 years. Permanent loss of reef habitat is not likely because the rock is relatively hard and will not be significantly abraded by the anchor and chain (as can happen in softer rock areas in other parts of UK).

**Conclusion 1:** The first priority is to identify potentially vulnerable areas of rock or reef under the farms using the maps created for the Baseline Benthic Habitat Survey Report. This is likely to be around the anchors and ground chains as well as riser chains they are most often in contact with the seabed.

1a) loss of habitat and 1b) physical damage from the anchors and chains will have also resulted in some degradation of the reef's structure and function and of its populations of typical species.

Relevant examples of the reef's function that may be degraded include biological productivity, biodiversity, reproductive capacity and other biological interactions. While the majority of the reef habitat is relatively poor quality due to sediment scour, the areas characterised by more sensitive communities and species deserve particular attention because any damage to them will result in greater and longer-term degradation of reef function and populations of some typical species. The significance of effect will therefore be judged largely on the quality of the reef that is lost or damaged (for up to 20 years).

Identifying locations where higher quality habitats are concentrated, particularly in the vicinity of the anchors and ground chains, will therefore provide valuable information for the assessment. It will also be important for the detailed design of the monitoring.

Any movement of the anchors or chains across reef habitat would cause damage to the reef communities through abrasion. Study of the existing seabed video footage from infrastructure inspection which was used to inform the Baseline Report shows some potentially scoured areas around the ground chains, but also some areas of chain and anchor which have been buried in the sediment with various communities now growing on and around them. A full and more detailed survey of the reef along the new ground chains is needed to assess how the seabed around these chains and anchors changes over time.

Improved knowledge of the distribution of the reef and its quality, in relation to the existing infrastructure, could potentially also offer options for mitigation by moving the anchors and chains small distances ('micro-siting') from areas of higher quality reef to areas that are already naturally scoured, as discussed in the Baseline Report.

**Conclusion 2:** Markers along infrastructure should be attached prior to deployment. This allows ROV surveys to follow the same transects over time and take comparable images of the areas each marker is on and around 1m on either side as a minimum. These images can also be compared to the Baseline Benthic Habitat Survey Report to assess potential changes in the seabed as a result of the infrastructure (e.g.abrasion).

As pre-installation data is already available, this can be used to compare reef quality from before the farms were extended with after the farms were extended. Markers such as cable ties or HDPE plastic markers should be placed along the ground chains at specified intervals and on each anchor to allow ROV/DDV footage to assess the same areas over time. If potential negative effects are recorded, it may be necessary to widen the assessment corridor to discover the extent of the effects. Stills from the video footage can be saved to illustrate the types of habitat being recorded as the transect progresses.

**Conclusion 3:** ROV/DDV footage can be used to assess impacts from oyster cages/potential smothering and shading from seaweed/shellfish lines above the seabed.

In response to the Baseline Benthic Habitat Survey Report, NRW expressed concern that increasing the farm sizes could create an area in the middle of underneath the farms which would be subject to smothering or shading from the lines above. It is expected that smothering from shellfish or seaweed debris and detritus would be minimal due to the high tidal flow rates and currents experienced where the farms are located, as well as the seabed habitat already being an area of highly mobile sediment even when over rock. The Baseline Benthic Habitat Survey Report did not show any

evidence of accumulations of mussel shells, for example, which would indicate that debris from the farms was settling underneath. The amount of sunlight reaching the seabed under the farms is minimal due to depth and turbidity of the water meaning there are small communities of algal turf consisting mainly of green and red seaweeds under Carn Ar Wig, with some kelp park noted under the northern edges of Porthlysgi. Studies comparing light levels underneath the farms versus control areas away from the farms have shown there is no significant effect in the difference between underneath the farms and a control area (PEBL, 2022). However, using the DDV or ROV, these areas underneath the farms can also be surveyed to confirm the expected effects. There are currently no oyster cages underneath the farms but surveying these areas for smothering/shading will also allow this footage to be used for comparisons to how oyster cages may affect the seabed in the future.

**Conclusion 4:** Repeat surveys (routine monitoring) of the defined survey sites would be carried out using a remote camera system to capture high resolution imagery. Post-survey analysis of the video would be carried out, for comparison with the habitat and community descriptions collected during the baseline survey.

NRW suggested in the previous monitoring plan for St Justinians that the monitoring programme should provide at least some quantitative data that can be used to assess any impacts of the farm mooring infrastructure on the reef.

A list of appropriate indicators and relevant quantification measures can be developed after the initial remote video survey has established the level of detail available from the footage; they would likely include percentage cover or counts per unit area of selected species and a measure of reef abrasion.

A survey unit of 0.1 $m^2$ (quadrat, 31.6 cm x 31.6 cm) would be appropriate, because it is large enough to contain multiple individuals of most of the likely indicator species and is small enough to be surveyed and photographed in one view by remote video camera in potentially moderate to poor visibility.

Cable ties or HDPE plastic markers would be placed at random intervals along ground chain and placed on anchors which would then allow for more detailed photographs/stills be taken from these areas along with overview footage from the whole length of chain which would provide both a zoomed in view of species close to the infrastructure as well as a zoomed out view of the scale of abrasion, if any.

Analysis (enumeration) of selected indicator species could be from photographs taken by the ROV/DDV providing there is sufficient resolution. Analysis from photographs is preferred in this situation because the likely indicators species are expected to be sufficiently conspicuous to be enumerated with reasonable accuracy and it will take less survey time to collect a larger number of photos. The communities of interest are also primarily within the circalittoral zone so unlikely to be obscured by a canopy of algae.

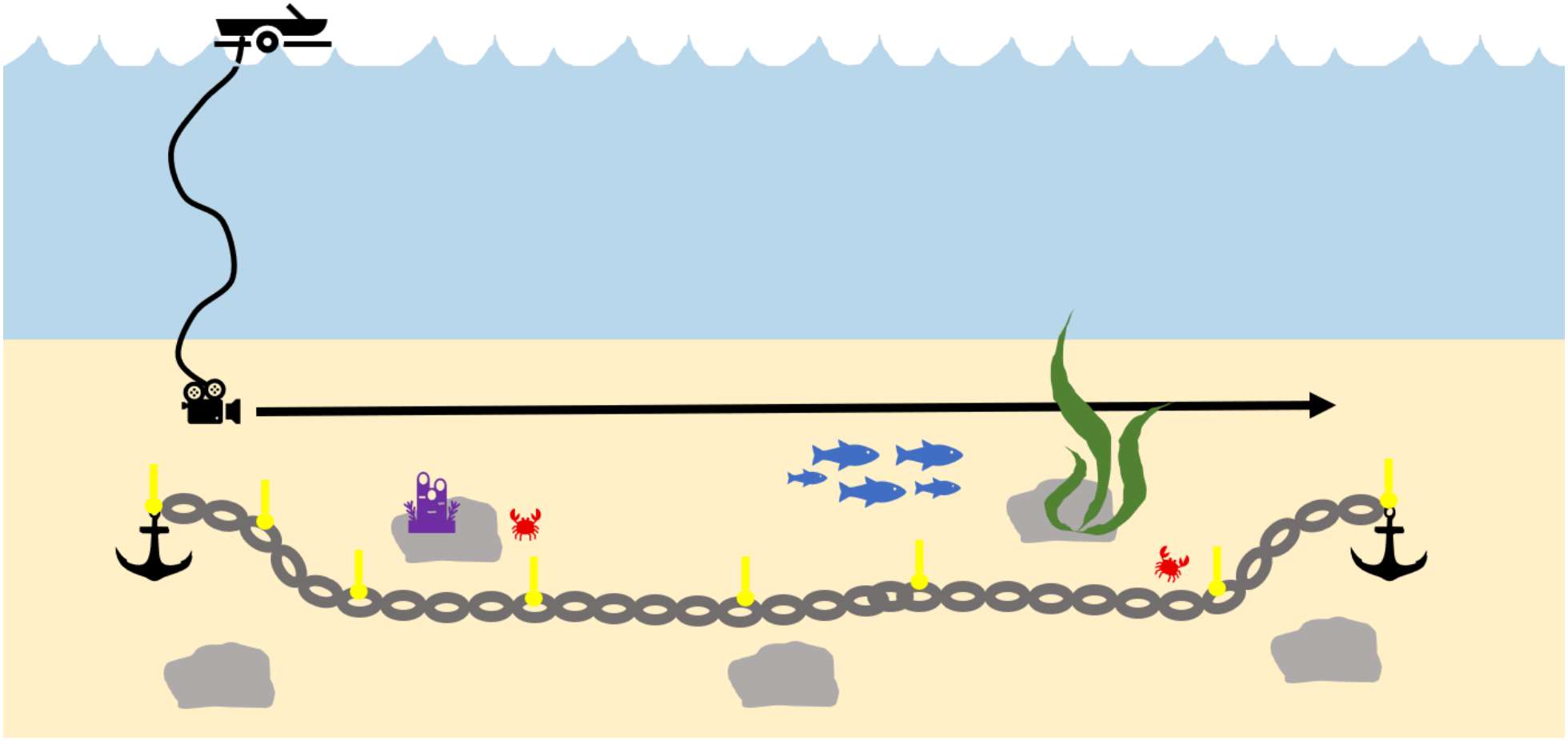

*Figure 8: Schematic illustration of ROV survey plan – ROV/DDV camera surveying fixed points (yellow HDPE plastic markers) along the infrastructure in situ on the seabed.*

## 4. Baseline survey

A baseline survey has already been carried out as part of the Marine License application process and can be read in full on the NRW website as 'Baseline Benthic Habitat Survey Report v5' in the DEML2540 documentation. The results of the baseline survey, including an assessment of the impacts of the farm infrastructure on the condition of the reef feature, were included in this document and submitted to NRW in June 2025.

## 5. Monitoring programme

- The subsequent inspections will be led in-house with support from PEBL CIC and Jon Moore.
- After further discussion with NRW, it has been agreed that the first survey will take place within 1-2 months after the infrastructure (anchors, ground chains and riser chains) has been deployed. The exact timing will depend on weather and tide conditions as well as PEBL and Jon's availability to assist with the surveying. The results from the survey will also be written up into a report and submitted to NRW Marine Licensing Team for approval 1 month after the survey has taken place. Subsequent surveys will be completed as close to the same time each year as possible, again subject to weather and tide conditions and availability of all partners.
- An ROV fitted with high-resolution camera tethered to a surface video feed and dragged along with a sled will be used to allow for precise control and navigation along the predetermined paths (Figure 8).
- Inspections will focus on the areas along the chain and anchors where markers were previously placed before deployment of the infrastructure. Transects under the middle of the farms will also be surveyed to determine impacts of oyster cages and smothering or shading from lines above.
- Video footage will provide a visual record of the reef's condition over time (1x per year). Comparing these subsequent inspection videos with the baseline data will help in understanding the impact of the seaweed farm's infrastructure on the reef ecosystem.
- Each inspection generates a detailed report that includes video analysis, findings, and any notable changes, and impacts observed. These reports will also make recommendations based on the results of monitoring considering if any mitigation is required to avoid impacts on sensitive/ high value areas of reef. Reports will be submitted to NRW for review once a year by September to allow a suitable weather window for surveying. Reports will give a description of the current habitat status and a comparison of the baseline vs newly collected data.
- The reports will also attempt to measure the effects of scouring from the farm infrastructure and assess this against the trigger points discussed below and their corresponding mitigation measures. This scouring would need to be confirmed to be from the farm structure and not due to natural scouring, which is a feature of these farms due to the location in highly dynamic environments. The scouring would also need to be determined as occurring on an ecologically significant scale related to the size of the farm, which will be assessed with support from PEBL and Jon Moore.

| Trigger Point | Mitigation Measure |
|---|---|
| Scouring deemed ecologically significant but small, localised effects from excess riser chain on the seabed | Adjusting riser lengths to avoid any contact with the seabed at low tide, potentially by adding additional buoys or weights to maintain tension |
| Scouring deemed ecologically significant and over wider areas around ground chains which | Adjusting the length and grade of the ground chain. E.g. we could replace with heavier |

| | |
|---|---|
| are loose across the seabed | ground chain and alter the length so that it either lifts vertically with minimal movement or remains settled on the seabed |
| Scouring deemed ecologically significant and causing damage over large areas, or where previous mitigation measures have been unsuccessful | Micrositing movement of anchors to areas of the seabed with habitats that are less susceptible to scouring effects; re-tensioning the farm by repositioning anchors, and potentially upgrading to larger anchors if movement is causing slack within the system. |
| Scouring deemed ecologically significant and causing significant damage over large areas and all previous mitigation measures have been unsuccessful and no other mitigation measures can be suggested | Removal of farm infrastructure in these areas and redesign of farm sections as appropriate |

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