Condition Assessments for the Designated Features of Ardal Cadwraeth Arbennig Y Fenai a Bae Conwy / Menai Strait and Conwy Bay Special Area of Conservation

Report No: 910

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Garth pier in the Meani Straits © NRW.

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Crynodeb Gweithredol

Er mwyn rheoli ein hardaloedd morol gwarchodedig yn effeithiol ac yn gynaliadwy, mae'n hanfodol deall cyflwr eu cynefinoedd a'u rhywogaethau gwarchodedig. Mae gwybod cyflwr nodweddion dynodedig yn caniatáu i ni dargedu rheolaeth ac adnoddau lle mae eu hangen i wella ac adfer cyflwr.

Mae'r adroddiad tystiolaeth hwn, a gyflwynwyd fel rhan o brosiect gwella cyngor cadwraeth forol (IMCA) a ariannwyd gan Lywodraeth Cymru, yn cyflwyno canfyddiadau asesiadau cyflwr Cyfoeth Naturiol Cymru ar gyfer Ardal Cadwraeth Arbennig (ACA) Y Fenai a Bae Conwy. Mae adran un yn rhoi trosolwg o'r broses asesu ac mae adran dau yn rhoi disgrifiad o'r ACA a'i nodweddion.

Mae'r asesiadau'n seiliedig ar y dystiolaeth orau a oedd ar gael ar y pryd (e.e. 2024). Adroddir canlyniadau asesiadau gyda hyder cysylltiedig yn y casgliad. Gellir dod o hyd i esboniadau manwl o'r rhesymeg y tu ôl i gasgliadau, ac unrhyw resymau dros fethu, yn yr asesiad cyflwr llawn yn Adran 3. Gellir dod o hyd i adroddiad ar y broses asesu a ddefnyddiwyd yn adroddiad terfynol IMCA.

Crynodeb o asesiadau cyflwr ar gyfer nodweddion dynodedig ACA Y Fenai a Bae Conwy.

Nodweddion ACA	Asesiad cyflwr	Hyder yn yr asesiad
Gwastadeddau llaid neu dywod nas gorchuddir gan y môr ar lanw isel	Ffafriol	Isel
Riffiau	Anffafriol	Canolig
Ponciau tywod sydd fymryn dan ddŵr y môr drwy'r amser	Anffafriol	Canolig
Cilfachau a baeau mawr bas	Anffafriol	Canolig
Ogofâu môr sy'n danforol neu'n lleddanforol	Anhysbys	Ddim yn berthnasol

Executive summary

To manage our marine protected areas effectively and sustainably it is vital to understand the condition of their protected habitats and species. Knowing the condition of designated features allows management and resources to be targeted where it is needed to improve and restore condition.

This evidence report, which was delivered as part of the Welsh Government funded improving marine conservation advice (IMCA) project, presents the findings of NRW's condition assessments for the designated features of the Menai Strait and Conwy Bay Special Area of Conservation (SAC). Section one gives an overview of the assessment process and section two provides a description of the SAC and its features.

The assessments are based on the best evidence available at the time (e.g. 2024). Assessment outcomes are reported with an associated confidence in the conclusion. Detailed explanations of the rationale behind conclusions, and any reasons for failure, can be found in the full condition assessment in Section 3. A report on the assessment process used can be found in the IMCA final report.

Summary of condition assessments for the designated features of Menai Strait and Conwy Bay SAC.

Feature	Condition assessment	Confidence in assessment
Mudflats and sandflats not covered by seawater at low tide	Favourable	Low
Reefs	Unfavourable	Medium
Sandbanks which are slightly covered by seawater all the time	Unfavourable	Medium
Large shallow inlets and bays	Unfavourable	Medium
Submerged or partially submerged sea caves	Unknown	Not applicable

1. Introduction

It is important for NRW to understand the condition of designated features in marine protected areas (MPAs) to allow NRW to prioritise management actions and advise on activity in the marine environment.

Having robust, evidence-based assessments of feature condition will ultimately lead to better protection through better management. The improvements in condition brought about by implementing targeted management will ultimately improve the resilience of Wales' marine ecosystems. As MPAs in Wales cover extensive areas of sea and coast, it can be challenging and resource intensive to monitor them. This can make thorough assessments of feature condition difficult. The process used for these condition assessments builds on work undertaken to produce indicative condition assessments published in 2018.

The 2018 indicative assessments used all available data and expert judgement to assess features using a workshop approach with internal NRW specialists. The new full assessment process, which has been delivered through the Welsh Government funded improving marine conservation advice (IMCA) project, has been improved by using carefully chosen performance indicators judged to be the most appropriate to assess condition (see Section 3). The best available evidence has been used to conduct the assessments. Due to the differences in assessment methods between these full assessments and the indicative condition assessments, the results are not directly comparable.

1.1.   Assessment process

Marine feature condition assessments in NRW consist of selecting performance indicators for the feature, gathering the best available evidence to assess those indicators and conducting the assessment.

Performance indicators have targets which have a primary, secondary or tertiary weighting. Failure of a primary target will mean the feature is classified as unfavourable, on a 'one out all out' basis. If all primary targets pass but two secondary targets fail, the feature would also be classified as unfavourable. Likewise, if all primary and secondary targets pass but three tertiary targets fail, the feature will also be unfavourable. Condition assessment outcomes are not strictly determined by target weightings and are also subject to expert judgement.

Each indicator result has an associated confidence which is determined by the quality and age of the evidence along with the confidence in the indicator itself and what it is telling us about condition of the feature. The confidence in the overall assessment is derived from the confidence in each target pass or failure, as well as expert judgment/ assessor consensus.

Each feature condition assessment will also identify reasons for indicator failure where known and any known threats to feature condition.

Table 1 summarises the steps taken in marine feature condition assessments. Details on the full condition assessment process, including indicator selection and target weighting can be found in the IMCA final report.

Table 1. The main steps of the marine feature condition assessment process.

Assessment Step	Process
Step 1: Preparation and evidence gathering.	Prepare site information. Source relevant evidence and any previous assessments. Evaluate quality of evidence according to suitability for use in assessments and carry out any analysis required.
Step 2: Indicator assessment.	A range of NRW specialists use all available evidence to assess the performance indicators and targets using a pass, fail or unknown. Record findings in the condition assessment form. Provide a confidence score for each target conclusion.
Step 3: Feature level assessments.	Combining the results from the assessment of feature indicators to provide an overall assessment of condition at the feature level.
Step 3.5. Complex features.	If the feature is a complex feature (i.e., estuaries or large shallow inlets and bays) consider the results of any nested feature assessments within the overall complex feature assessment.
Step 4: Condition pressures and threats.	Use the evidence gathered and information on management and activities to determine threats and pressures on feature condition.
Step 5: Finalise the assessments.	Ensure all required fields in the assessment have been completed and all assessed targets have an associated confidence. Circulate the reports to the relevant NRW specialists for review and comment. After issues have been resolved, the assessments will be signed off by the project task and finish group.
Step 6: Publish the assessments.	After signing off, the assessments will be published on the NRW website, and stakeholders and internal staff notified. Assessments are then ready to use by internal and external parties.

2. SAC description

The ardal cadwraeth arbennig Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay special area of conservation (SAC) is in north west Wales. The site covers the whole of the Menai Strait and extends from Menai Point in the west to the Little Orme/ Rhiwledyn in the east and Traeth Lligwy on Anglesey in the north. The SAC covers approximately 26,483 hectares. It forms part of the UK's National Site Network.

The site was designated in 2004 under Article 4.2 of the Conservation of Natural Habitats and of Wild Fauna and Flora Directive (92/42/EEC) for five habitat features under Annex I. It is one of the best areas in the UK for the following features:

- Mudflats and sandflats not covered by seawater at low tide (abbreviated to mudflats and sandflats)
- Reefs
- Sandbanks which are slightly covered by seawater all the time (abbreviated to sandbanks)

And supports a significant presence of:

- Large shallow inlets and bays (abbreviated to LSIB)
- Submerged or partially submerged sea caves (abbreviated to sea caves)

Figure 1 is a map of the location of the designated features within Menai Strait and Conwy Bay SAC. The feature maps in this document are for illustrative purposes only. Detailed maps for the features in Wales can be found on Data Map Wales.

More information on the SAC and its features can be found in NRW's conservation advice for the site on our website.

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Figure 1. Map of the designated features of the Menai Strait and Conwy Bay SAC.
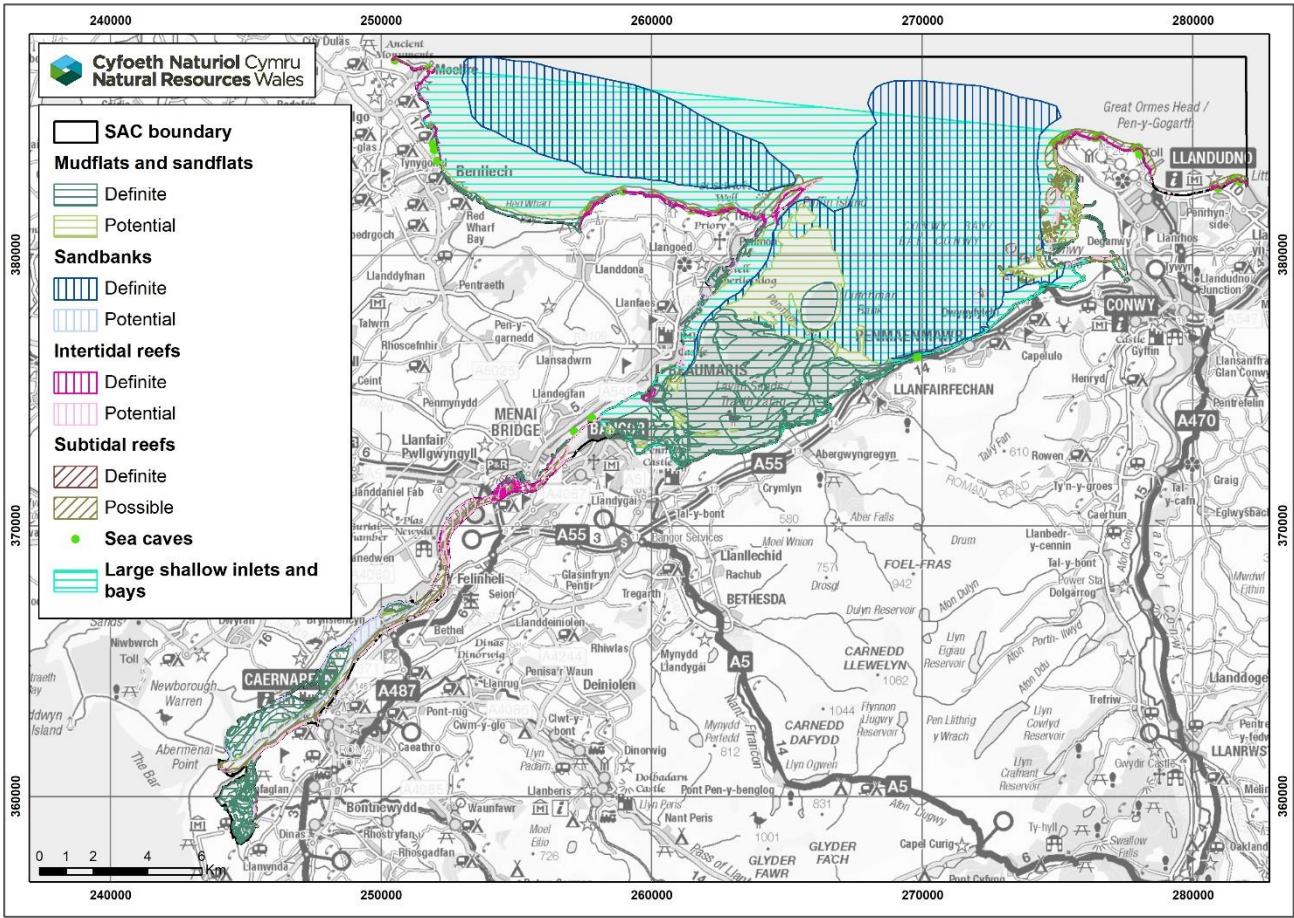
3. Feature condition assessments for Menai Strait and Conwy Bay SAC

This section contains assessments for the following designated features in Menai Strait and Conwy Bay SAC:

- Mudflats and sandflats not covered by seawater at low tide
- Reefs
- Sandbanks which are slightly covered by sea water all the time
- Large shallow inlets and bays
- Submerged or partially submerged sea caves

Each feature has been assessed against their own performance indicators using all available evidence. The performance indicators were assessed using a combination of data from NRW Habitats Regulations monitoring, Water Framework Directive (WFD) Regulations 2017 (WFD Regulations) monitoring, commissioned evidence reports, scientific literature, plan and project assessments, external monitoring databases (e.g. National Biodiversity Network) and expert judgement. The outcome of the assessment and reasons for failure are discussed in more detail in the sections below.

In these condition assessments, the WFD 2024 cycle 3 interim classification was the default information used for water quality, however other earlier cycles were referenced, as follows:

- 2009 cycle 1 classification
- 2015 cycle 2 classification
- 2018 cycle 2 interim classification
- 2021 cycle 3 classification

In the WFD classification, results are rolled forward from previous assessments where there are no new monitoring data to provide a new classification. It is used to gap fill and provide a more complete classification. A decision was made to limit roll forward to six years which has been applied to the 2024 cycle 3 interim classification

Additional information on water quality can be found in the IMCA final report.

3.1. Mudflats and sandflats condition assessment

The mudflats and sandflats feature in the Menai Strait and Conwy Bay SAC is comprised of a number of mudflats and sandflats (Figure 2). However, the NRW Habitats Regulations monitoring has been focused on sampling points within muddy gravel sites in Beaumaris, Fryars Bay, Lleiniog, and the mudflats and sandflats in Traeth Lafan and Y Foryd. These locations were surveyed between 2004 and 2022 using core sampling as part of the NRW Habitat Regulations monitoring survey.

Figure 2. Map of the mudflats and sandflats feature in Menai Strait and Conwy Bay SAC.
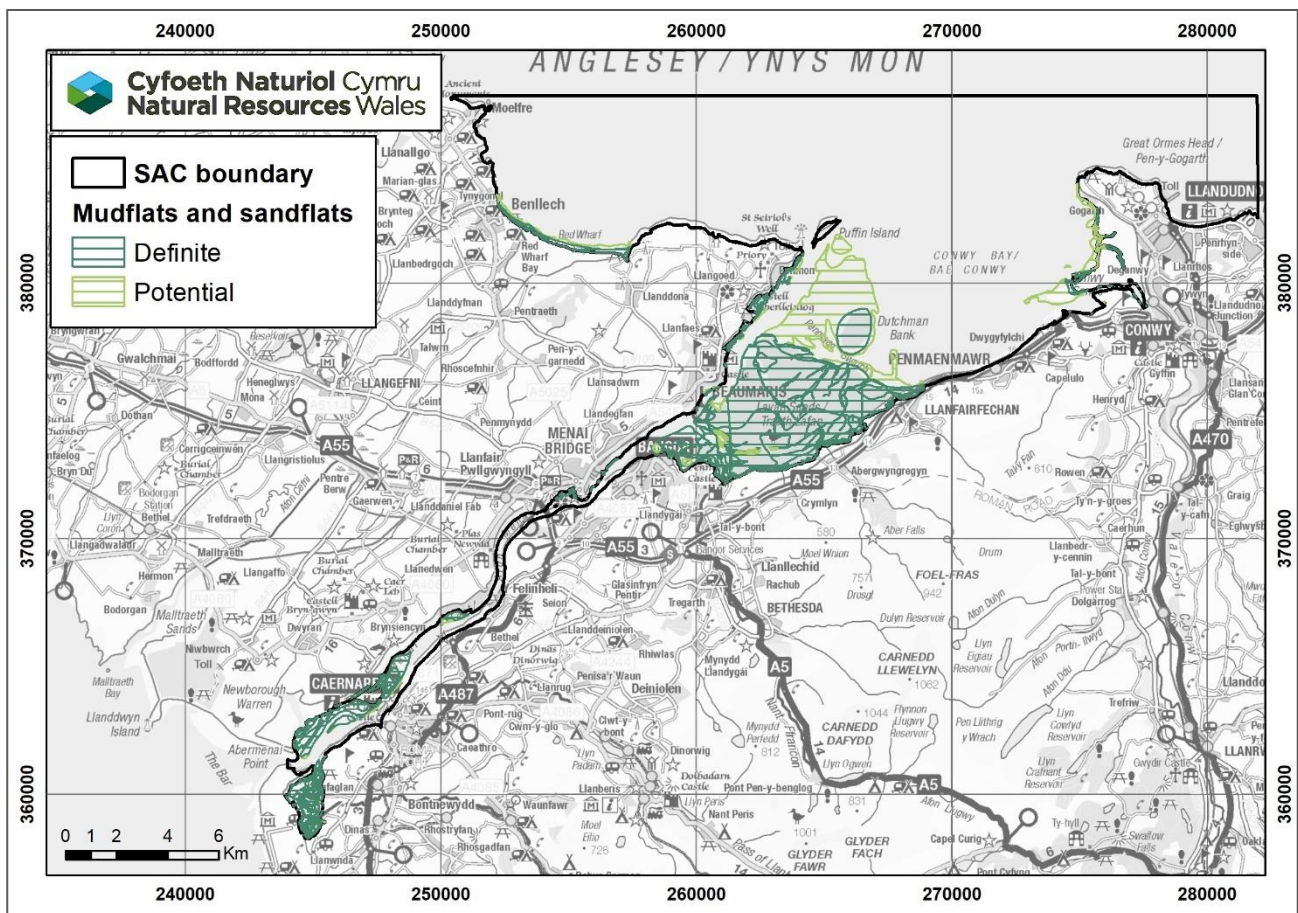
Table 2 has a summary of the assessment outcome. This outcome and reasons for failure are discussed in more detail in the sections below.

Table 2. Condition assessment of mudflats and sandflats in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see Section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Feature extent	No significant decrease in the extent of mudflats and sandflats within the SAC, allowing for natural change and variation. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the extent of the mudflats and sandflats feature in the Menai Strait and Conwy Bay SAC. • Confidence is medium as the assessment has not been based on comparison mapping of the feature and expert judgment was used.	**Pass**	Medium
Distribution and extent of habitats and communities	Maintain the distribution and extent of mudflats and sandflats habitats and communities, allowing for natural change and variation. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the distribution and extent of habitats and communities of the mudflats and sandflats feature in the Menai Strait and Conwy Bay SAC. • Confidence is medium as expert judgement has been used to assess this indicator in the absence of recent data.	**Pass**	Medium
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of the mudflats and sandflats. (S)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of the mudflats and sandflats feature in the Menai Strait and Conwy Bay SAC. • Confidence is medium as expert judgement has been used to assess this indicator in the absence of recent data.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity, allowing for natural variation and change. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the hydrodynamic and sediment transport processes of the mudflats and sandflats feature in the Menai Strait and Conwy Bay SAC. • Confidence is medium as expert judgement has been used to assess this indicator in the absence of recent data.	**Pass**	Medium
Sediment composition and distribution	Maintain composition and distribution of sediment granulometry across the mudflats and sandflats, allowing for natural change and variation. (P)	• Granulometric analysis from the Habitats Regulations monitoring program for Traeth Lafan, Beaumaris, Fryars Bay and Lleiniog mudflats and sandflats showed little variation in sediment composition across the monitoring time. • Sediment composition from WFD data indicated very little change at Foryd Bay. • Confidence is high due to the long term data set and knowledge that there were no anthropogenic activities nearby that are known to impact the sediment composition.	**Pass**	High
Sediment quality: oxidation-reduction profile (redox layer)	No decrease in the depth of the redox layer from the surface that is considered detrimental to mudflats and sandflats infaunal communities, allowing for natural change and variation. (S)	• The redox layer indicated no clear trend over the years. • There is some evidence the redox layer is decreasing in depth in some monitoring stations. • Confidence is low because additional sampling is needed to improve temporal resolution and data continuity, which are required to understand ongoing processes and confirm overall trends.	**Pass**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: nutrients (Dissolved Inorganic Nitrogen - DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (P)	• Six of the seven WFD waterbodies that overlap with the feature were classified as Good or High status for DIN in the 2024 cycle 3 interim classification (Conwy Bay, Menai Strait, North Wales, Conwy, Foryd Bay and Seiont). Combined, these overlap with 98% of the feature. • One WFD waterbody was not classified for the DIN WFD element, however it overlaps with only 2% of the feature (Anglesey North). • Confidence is high as the waterbodies that overlap with a large proportion of the feature were classified and there were no failures for the DIN element.	**Pass**	High

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: phytoplankton	The WFD classification achieved for phytoplankton should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• One of the seven WFD waterbodies was classified with a Moderate status for phytoplankton in the 2024 cycle 3 interim classification (North Wales). However, it overlaps with <1% of the feature. • Two WFD waterbodies were not classified for this WFD element (Anglesey North and Seiont). However, combined these overlap with only 2% of the feature. • The other four WFD waterbodies were classified with Good or High status for phytoplankton (Conwy Bay, Menai Strait, Conwy and Foryd Bay). Combined, these overlap with 98% of the feature. o The Menai Strait and Foryd Bay waterbody classifications were rolled forward from previous cycles. • Confidence is medium due to rolled forward classifications, and as the ecological relationships between phytoplankton and the mudflats and sandflats feature are not fully understood.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: opportunistic macroalgae	The WFD classification achieved for opportunistic macroalgae should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• Four of the seven WFD waterbodies have not been classified for opportunistic macroalgae in the 2024 cycle 3 interim classification (Menai Strait, Anglesey North, Conwy Bay and North Wales). Combined, these overlap with 95% of the feature. • The other three WFD waterbodies were classified with a Good or High status for opportunistic macroalgae (Conwy, Foryd Bay and Seiont). Combined, they overlap with 5% of the feature. o The Seiont waterbody classification was rolled forward from the 2018 cycle 2 interim classification. • Confidence is low as a large proportion of the feature overlap with waterbodies that have not been classified for this WFD element.	**Pass**	Low
Water quality: dissolved oxygen	The WFD classification achieved for dissolved oxygen should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• Six of the seven WFD waterbodies that overlap with the feature have been classified with High status for dissolved oxygen in the 2024 cycle 3 interim classification (Menai Strait, Foryd Bay, Anglesey North, Conwy Bay, Conwy and North Wales). Combined, these overlap with nearly 100% of the feature. • One WFD waterbody was not classified, however this waterbody overlaps with <1% of the feature (Seiont). • Confidence is medium due to samples being taken from the surface of the waterbodies.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: contaminants	Water column contaminants not to exceed the environmental quality standards (EQS). (S)	• Two of the seven WFD waterbodies have a pass for chemicals in the 2024 cycle 3 interim classification (Menai Strait and North Wales). In both of these waterbodies the classifications were rolled forward from previous cycles as they were not classified in the 2024 cycle 3 interim classification. The Menai Strait waterbody overlaps with 91% of the feature. • One WFD waterbody was not classified as the chemicals have not been assessed within the last six years (Seiont). This waterbody overlaps with a very small proportion of the feature. • The other four WFD waterbodies have a fail for chemicals (Foryd Bay, Anglesey North, Conwy Bay and Conwy). Combined, these overlap with 9% of the feature. Chemicals that failed were mercury, polybrominated diphenyl ethers (PBDE), polycyclic aromatic hydrocarbons (PAH) and cypermethrin. • Confidence is low as: the failing waterbodies overlap with a small proportion of the feature; the human health standard has been used for PBDE; and due to the roll forward of some chemical classifications.	**Fail**	Low
Water quality: turbidity	Maintain expected levels of turbidity, allowing for natural change and variation. (S)	• There are limited turbidity data for the mudflats and sandflats feature in the Menai Strait and Conwy Bay SAC, therefore this target was assessed as unknown.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: physicochemical properties	Maintain expected physicochemical properties of the water, allowing for natural change and variation. (S)	• Data from subtidal temperature loggers from within the SAC were available. Loggers at one monitoring site indicated a potential increase in temperature in recent years. It is not clear if this is a localised change or in line with global trends. Loggers at the other monitoring site were missing a large amount of data between 2016 and 2021. • An external report from Bangor University indicates that annual mean sea surface temperature is gradually rising in their Menai Strait temperature logger. • It is not understood if the observed increases in temperature are localised to the SAC, or if they are consistent with the effects of climate change. • This indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Abundance, distribution and species composition of communities	Maintain the abundance, distribution, and diversity of species within communities and component habitats, allowing for natural change and variation. (P)	• One of the seven WFD waterbodies, Conwy Bay, was classified as Moderate status for the Infaunal Quality Index (IQI) WFD element in the 2024 cycle 3 interim classification. This waterbody overlaps with a small proportion (1%) of the feature therefore was not considered to fail the feature. Four WFD waterbodies, which overlap with 98% of the feature were classified with a Good or High status. • Analysis of macrobenthic infaunal communities in muddy gravel locations indicated a shift in species composition, with species associated to very muddy gravel habitats in 2004, to species associated with sandier habitats in 2013. Communities have remained more stable in recent years (up to 2022). These trends are unexplained but concern is low as there is no known anthropogenic impact to date and species composition was more stable in the last reporting cycle. • Analysis of macrobenthic infaunal communities for Traeth Lafan showed that communities remained broadly similar over time and within natural fluctuations. • Abundance of cockles *Cerastoderma edule* was assessed to be low during surveys at Traeth Lafan, but biomass was fairly consistent. • WFD data indicated that the extent of seagrass *Zostera noltei* has increased in the Foryd Bay waterbody. • Confidence in this pass is medium due to the unexplained change in species composition in muddy gravel locations since 2004.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Species richness and diversity	Maintain the expected richness and diversity of mudflats and sandflats species, allowing for natural change and variation. (S)	• Analysis showed some decrease of taxa richness and diversity at muddy gravel sites. • A decline in taxa richness was also observed at Traeth Lafan sites (e.g. 2018). ○ These decreases were not deemed to be outside of what would be expected from natural change and variation, but some concerns remain. This lowered the confidence of the target assessment pass to medium.	**Pass**	Medium
Taxonomic spread of species	Maintain the expected taxonomic spread of mudflats and sandflats species, allowing for natural change and variation. (S)	• Overall, the average taxonomic distinctness of the macrofaunal community of Traeth Lafan mudflats remained stable and within the expected values over the monitoring period. • For muddy gravel sites, the results throughout the monitoring period are lower than the expected level of taxonomic spread, however this may be due to natural change. The low values could possibly be explained by the specific nature of the site. The test used, taxonomic average distinctness, might not be suitable for the muddy gravel habitat. • Confidence is low due concerns over the lower taxonomic spread in muddy gravel sites.	**Pass**	Low
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities is not adversely altering ecosystems. (P)	• There is limited evidence to suggest that INNS (e.g. *Crepidula fornicata*) are currently impacting the condition of the mudflats and sandflats in the SAC. • Confidence is low as the spread and impacts of the INNS present within the feature are not well understood.	**Pass**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• *C. fornicata* became established around 2019 in the Menai Strait and numbers are increasing substantially. Records are within or very close to the mudflats and sandflats feature. • The red seaweed worm wart weed *Gracilaria vermiculophylla* has been recorded within the last six years in the Traeth Lafan sandflats in the Menai Strait, which is within the mudflats and sandflats feature. • Other NNS have been recorded previously including the Chilean oyster *Ostrea chilensis,* Pacific oyster *Magallana gigas* and wireweed *Sargassum muticum* in the Menai Strait (within or close to the feature). • Confidence is high due to the arrival of NNS within the last six years, and good availability of records.	**Fail**	High

Assessment conclusions

The mudflats and sandflats feature in Menai Strait and Conwy Bay SAC has been assessed as being in **favourable** condition (low confidence). Overall, the lack of any significant anthropogenic impact on this feature in terms of extent, hydrodynamic processes, topography, sediment composition and its associated communities, have contributed to this favourable assessment outcome. There were two failing indicators, but none with a primary weighting (Table 3). There were also limited or absent data for two key indicators (sediment quality: organic carbon and sediment quality: contaminants) to inform on the condition of the feature (see the evidence gaps). This has reduced the confidence in the assessment conclusion. Further investigation is needed to better understand all of the indicator failures to be able to identify management options.

A summary of the assessment can be seen in Table 3 with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 3. Summary of the condition assessment for mudflats and sandflats in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

Feature	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Mudflats and sandflats	**Favourable (low confidence)**	Water quality: contaminants (S) Non-native species (T)	• Levels of mercury, PBDE, PAH and cypermethrin in the Foryd Bay, Anglesey North, Conwy Bay and Conwy waterbodies are failing to meet their relevant environmental quality standards (EQS). • There has been an increase in the number of NNS in the feature SAC, including *C. fornicata* and *G. vermiculophylla*.	• Unconsented infrastructure • INNS • Water quality: contaminants • Management of coastal defences • Climate change

Detailed assessment information

Extent and distribution

The feature extent and the distribution and extent of habitats and communities indicators in the Menai Strait and Conwy Bay SAC passed their targets. There are currently no known anthropogenic impacts that would negatively affect the mudflats and sandflats feature. Comparison mapping has not been used to assess the extent and expert judgment was used to assess communities distribution in the absence of recent data. This has reduced the confidence to medium.

Sediment quality; topography; and hydrodynamic and sediment transport processes

Overall, sediment composition varied slightly across the monitoring period, but the variation was deemed to be within the expected range of natural variation. There was a recent increase of silt content at Fryars Bay, but this was not considered to be a concern. This target passed with high confidence based on the knowledge that there were no anthropogenic activities nearby that are known to impact the sediment composition of the mudflats and sandflats. Analysis of the data showed that macrofaunal abundance was positively correlated (moderate relationship) to the sediment composition for Traeth Lafan mudflats and sandflats, indicating that communities are to some extent determined by sediment characteristics.

The redox layer profile indicated no clear trend over the surveyed years. An extensive macroalgae layer has been reported in Foryd Bay that could lead to anoxic conditions, but no measurements of the redox layer were taken to confirm this. A long-term data series spanning from 2004 to 2022 is available, but sampling has not been conducted consistently every year. Further sampling is required to enhance the robustness and completeness of the dataset, especially important for assessing the redox layer. For this reason the confidence in the pass was reduced to low.

There is no monitoring of sediment contaminants or organic carbon content within the SAC. These indicators were therefore not assessed.

The topography, hydrodynamic and sediment transport processes are not well researched for intertidal mudflats and sandflats. These targets passed with medium confidence based on the knowledge that there are currently no anthropogenic activities that are known to have a significant impact on the feature.

Water quality

It has been estimated that nearly 100% of the mudflats and sandflats feature within the SAC falls within seven WFD waterbodies. These are therefore likely to be a good reflection of the overall effect of water quality on the feature. The Menai Strait waterbody overlaps with a large proportion of the feature (approximately 91%). Two of the seven WFD waterbodies, North Wales and Seiont, overlap with a very small proportion of the mudflats and sandflats feature (<0.5%), therefore they have not been considered further in the condition assessment.

Nutrients (Dissolved Inorganic Nitrogen - DIN only), phytoplankton and opportunistic macroalgae

The indicators for nutrients (DIN only) and phytoplankton met their targets. For the nutrients indicator (DIN only), a large proportion of the feature (98%) overlaps with WFD waterbodies classified as Good or High status for DIN in the 2024 cycle 3 interim classification. One WFD waterbody (Anglesey North) was not classified for the DIN element in the 2024 cycle 3 interim classification as there were no data collected on this element over the last six years. However, it overlaps with a small proportion of the feature (2%). The Menai Strait waterbody overlaps with the largest part of the feature and was classified as High status for DIN, and it has improved from Moderate and Good status in previous cycles to High status since the 2018 cycle 2 interim classification.

The confidence in the pass for the phytoplankton indicator was reduced to medium. This was because the High status classification in the 2024 cycle 3 interim classification for the Menai Strait waterbody was rolled forward from the 2018 cycle 2 interim classification. In addition, the ecological relationships between phytoplankton and the mudflats and sandflats feature across all SACs are not fully understood. Two WFD waterbodies were not classified for the element, however they overlap with a small proportion of the feature (2%). Classification of some of these waterbodies may not be suitable or possible for this element due to WFD classification methodology, or due to the nature of the waterbodies (e.g. turbidity levels).

The opportunistic macroalgae indicator met its target as three of the overlapping WFD waterbodies were classified as Good or High status for this element in the 2024 cycle 3 interim classification (Foryd Bay, Conwy and Seiont). Combined, these waterbodies overlap with 5% of the feature. There have been observations of nuisance algae in the watercourses that feed into the Foryd Bay waterbody therefore sampling may not be suitable to pick up issues. This waterbody overlaps with a small proportion of the feature (4%) therefore this observation did not lead to a failure, but will be something to pay close attention to in the next assessment. The other four WFD waterbodies that overlap with the feature were not classified for opportunistic macroalgae in the 2024 cycle 3 interim classification. This includes the Menai Strait waterbody, which overlaps with the largest proportion of the feature. Some WFD waterbodies are not assessed for opportunistic macroalgae as they do not have suitable substratum (i.e. areas of intertidal habitat for opportunistic macroalgal growth). The confidence in the pass was reduced to low as the waterbodies classified for the relevant element overlap with a small proportion of the feature.

Dissolved oxygen

The dissolved oxygen indicator met its target. The dissolved oxygen samples were taken at the water's surface. By the time oxygen depletion at the surface is recorded, oxygen throughout the water column could have been depleted for some time, especially as hypoxia or low oxygen levels, when present, typically occur in bottom water and sediments. Therefore, surface sampling of dissolved oxygen may not detect issues for more demersal features. This reduced the confidence in the pass to medium.

Contaminants

Four of the seven WFD waterbodies that overlap with the mudflats and sandflats feature in the SAC have a fail for chemicals in the 2024 cycle 3 interim classification. Combined, these waterbodies overlap with approximately 9% of the mudflats and sandflats feature. This caused the contaminants indicator to fail. The failures were for the Anglesey North (mercury and polybrominated diphenyl ethers (PBDE)), Conwy Bay (polycyclic aromatic hydrocarbons (PAH)), Foryd Bay (mercury), and Conwy (PBDE, mercury, PAH and cypermethrin) waterbodies.

There has been a waterbody status change from pass to fail in the Conwy Bay waterbody between the 2021 cycle 3 classification and the 2024 cycle 3 interim classification, however the failing contaminant (PAH) was not classified in previous cycles. Similarly, in the Conwy waterbody, two of the failing contaminants (PAH and cypermethrin) were not previously classified. With the exception of the 2021 cycle 3 classification, mercury has failed in this waterbody in all classifications since the 2015 cycle 2 classification. The waterbody status changes for mercury between cycles are likely due to changes in WFD classification methodology. Cypermethrin is a synthetic pyrethroid insecticide and is highly toxic to some aquatic species (EA, 2019), but now has a restricted use in Wales. The environmental quality standards (EQS) for cypermethrin is very low, and in the previous laboratory methodology, it was not possible to detect concentrations below the EQS. There was an additional failure for zinc in the 2021 cycle 3 classification the Conwy waterbody, but this no longer fails in the 2024 cycle 3 interim classification. In the Anglesey North and Foryd Bay waterbodies, mercury has failed since the 2015 cycle 2 classification. The EQS for mercury is based on the secondary poisoning protection goal (for wildlife). The PBDE failures were based on the value of the human health protection goal as it is the most stringent. This protection goal may be over precautionary as the effect of contaminants on the biota of mudflats and sandflats are not fully understood. The confidence in the fail was reduced to reflect this.

The other two overlapping WFD waterbodies have a pass for chemicals in the 2024 cycle 3 interim classification. However, in both WFD waterbodies the classifications were rolled forward from previous cycles as they were not classified in the 2024 cycle 3 interim classification. This includes the Menai Strait waterbody which overlaps with the largest proportion of the feature. This also contributed to the reduced confidence. Confidence was further reduced to low as the failing waterbodies overlap with a small proportion of the feature. In addition, the impact of the failing contaminants on the feature are not fully understood.

Turbidity and physicochemical properties

The turbidity indicator was assessed as unknown due to insufficient data. There were some data available from WFD Regulations sampling of suspended particulate matter. However, this is limited to only a few samples per year and therefore cannot be used to adequately assess the turbidity.

Data from NRW monitored subtidal temperature loggers from two sites within the SAC were available. However, as loggers from one of the monitoring sites had a large amount of missing data, the observed patterns in temperature are based on data from only one monitoring site which overlaps with the feature. These loggers showed an increase in temperature in more recent years. An external report (Smyth et al., 2022) also found that

the annual mean sea surface temperature was gradually rising in the Menai Strait. It is not understood if the observed increases in temperature are localised to the SAC, or if they are consistent with the effects of climate change. The physicochemical indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).

Species and communities

One of the seven relevant WFD waterbodies that overlaps with the mudflats and sandflats feature, Conwy Bay, was classified as Moderate status for the Infaunal Quality Index (IQI) element in the 2024 cycle 3 interim classification. This waterbody overlaps with a very small proportion of the feature (approximately 1%) therefore this has not been considered to fail the feature. Four WFD waterbodies were classified as Good or High status for the IQI element (Menai Strait, Foryd Bay, Anglesey North and Conwy). Combined, these waterbodies overlap with 98% of the mudflats and sandflats feature. The other two waterbodies (North Wales and Seiont) were not classified for this element.

Infaunal analysis showed that whilst communities associated with Traeth Lafan mudflats and sandflats varied across the assessment monitoring period, they remained broadly similar over time with no major shift detected (Moore, 2018 and NRW unpublished data). As a result, the variation in composition of communities was judged to be natural. There have been some noticeable changes with distinct community composition in muddy gravel locations in 2004 compared to more recent years (up to 2022). Species in 2004 tended to belong to very muddy gravel habitat while taxa from recent years and northernmost stations tended to belong to sandier habitat. These trends are unexplained but concerns are low as there is no evidence to suggest the observed changes are attributable to anthropogenic activity. In addition, the species composition was more stable in the last reporting cycle.

Infrequent surveys on cockles *Cerastoderma edule* indicated that while biomass is fairly small, it has remained steady over the years. Evidence suggests that the seagrass *Zostera noltei* extent has increased in recent years in the Foryd Bay waterbody. The seagrass element was consistently given a High status in WFD cycles and remains High in the latest 2024 cycle 3 interim classification for the Foryd Bay waterbody. Other WFD waterbodies were not classified for the seagrass element in the WFD classification.

Overall, the abundance, distribution and species composition of communities indicator met its target. However, the confidence in the pass was reduced to medium due to unexplained changes in muddy gravel species composition. Available data for some mudflats and sandflats associated species on the distribution and population structure were lacking or insufficient. Although these data were not required for the full assessment of the abundance, distribution and species composition of communities indicator, having detailed information on these would strengthen the outcome and could be considered in future.

Small changes at the muddy gravel sites were observed in species richness and diversity with a slight reduction in taxa number in recent years. There was also some decrease of taxa richness at Traeth Lafan sites (e.g. 2018). While the decrease is concerning, there is no evidence to suggest that there is an ongoing decline. Changes in abundance can affect species richness and this could be the case with Traeth Lafan species richness. These

declines were not deemed large enough to fail the target but did reduce confidence in the pass and will be something to pay close attention to in the next assessment.

The average taxonomic distinctness of the infaunal community at Traeth Lafan remained relatively stable across the monitoring period. Whilst taxa number was low, the average taxonomic distinctness was within the expected values with the exception of a few stations in 2015 and 2018. The taxonomic distinctness analysis for the muddy gravel sites showed that most of the stations across the monitoring period were below the expected level. This could possibly be explained by the different sediment composition of muddy gravel compared to typical mudflats and sandflats from which the taxonomic aggregation file is compared with (i.e. the main taxonomy of samples was compared with the overall taxonomy of the entire dataset). While the average number of taxa was higher at muddy gravel sites than for other typical muddy / sandy sites, more than half of the taxa belonged to one class (e.g. polychaete) of the total 20 classes. The majority of taxa for a typical muddy / sandy site, like in the Crofty mudflats and sandflats in the Carmarthen Bay and Estuaries SAC, is more evenly spread within three dominant classes (e.g. polychaete, Malacostraca and Bivalvia) of the total of 10 classes. Nevertheless, while below the expected value, the average taxonomic distinctness for muddy gravel remained relatively stable across the monitoring period and for this reason, the indicator met its target but with low confidence.

Invasive non-native species

There were records of the American slipper limpet *Crepidula fornicata* identified in 2006 however, following an eradication attempt, no records of the species were identified for a number of years. More recently, within the last six years, this species has become established (i.e. since 2019) and numbers are increasing. These records are within or very close to the mudflats and sandflats feature. This resulted in a fail for the tertiary target of the non-native species (NNS) indicator. Similarly, the red seaweed worm wart *Gracilaria vermiculophylla* has been recorded within the last six years in the sandflats at Traeth Lafan (Mercer and Brazier, 2023). The tertiary target of the NNS indicator failed with high confidence due to the new NNS recorded in the mudflats and sandflats feature within the last reporting cycle.

Other NNS are known to be present in the Menai Strait (within or very close to the mudflats and sandflats feature) including the Chilean oyster *Ostrea chilensis,* Pacific oyster *Magallana gigas* and the wireweed *Sargassum muticum.* Limited records have been produced for *O. chilensis,* but it has been known to be present in the Strait for about 30 years. The cover of *S. muticum* is thought to be extensive in the SAC, however this species is not consistently recorded. *S. muticum* has replaced the zone of sugar kelp in some areas in the Menai Strait but it is thought that it has not expanded significantly in recent years.

It is not fully understood how some of these species may spread and impact the condition of the mudflats and sandflats feature and effects on the species diversity and composition have not yet been observed. As there is no current impact from the invasive non-native species (INNS) present the primary target of the INNS indicator passed. Confidence is low as the spread and impacts of the INNS present within the feature are not well understood.

Reasons for target failure

The mudflats and sandflats feature in Menai Strait and Conwy Bay SAC has been assessed as being in **favourable** condition. However, one secondary target and one tertiary target failed to be met and need to be kept under review.

Water quality: contaminants

This indicator target has a secondary weighting. The mudflats and sandflats feature is partly within four WFD waterbodies (Anglesey North, Foryd Bay, Conwy Bay and Conwy) that have a fail for chemicals due to mercury, PBDE, PAH and cypermethrin. Historically, the main source of PBDE is as flame retardants in a variety of materials (Viñas et al., 2022). Mercury has been used in many industries, but today the primary sources are burning of coal and artisan mining for mercury (Larsen and Hjermann, 2022). PAHs can be produced through natural processes, but also arise from anthropogenic sources, for example during combustion of fossil fuels and organic material (Webster and Fryer, 2022). Cypermethrin is an insecticide used for plant protection in crops, in forestry, gardens, homes and businesses. It is also used in veterinary medicine to control pests in livestock and pets (EA, 2019). The application of cypermethrin has been restricted for some uses (sheep dipping and in forestry against the pine weevil).

Some of the contaminants in the water column may be derived from diffuse sources including atmospheric deposition or contaminated waterbody bed sediments. However, WFD investigations of the failures in all four WFD waterbodies are yet to be undertaken. Mercury and PBDE are being managed in the UK and it is hoped that these levels will reduce over time. There is currently no specific management in place for PAH in Wales. The PAH EQS is based on the most sensitive taxa and may not be applicable to all of the mudflats and sandflats biota. The impact of PAH on the mudflats and sandflats feature is not fully understood.

Non-native species

This indicator failed to meet its tertiary target of no increase in the number of introduced NNS by human activities. The failure of the tertiary target is due to the increase in records of NNS in the mudflats and sandflats feature, including *C. fornicata* and *G. vermiculophylla* within the last six years. Investigation into the management of spread of *G. vermiculophylla* has not been done widely (Maggs and Magill, 2014). Targeted surveys of the species and investigation into its impact are required.

The spread and full extent of the impact that these species, along with other NNS present within the SAC, may have on the condition of the feature is currently unknown. For this reason it did not fail the primary target of the INNS indicator. A biosecurity plan for INNS has been developed for the SAC. The objective is to manage the key pathways by which marine INNS are introduced and spread at the SAC level through the use of good biosecurity.

Threats to condition

Part of the condition assessment is to identify threats to the condition of the mudflats and sandflats feature. A threat is defined as an activity that is currently not impacting condition

but has the potential to do so over the next reporting cycle, if activity levels increase or are unmanaged. It is important to identify these threats to be able to put pre-emptive management in place to prevent declines in condition.

Activities that go through licencing and permission processes whereby the impact of the activity on the feature would be assessed have not been included. The threats to the mudflats and sandflats feature condition in the Menai Strait and Conwy Bay SAC are stated below.

Unconsented infrastructure

New unconsented infrastructures such as private slipways and coastal defences modify the coastal environment through changes to micro-topography and hydrodynamics and can lead to loss of the feature extent, and impact to the flora and fauna associated with it.

Invasive non-native species

There have been concerns about the increasing abundance of *C. fornicata* in the SAC. This species is commonly found in areas of muddy gravel habitat. At high density, it could cause an impact on the mudflats and sandflats feature as it has been shown to alter habitats if it settles in large numbers (Blanchard, 2009). It can also compete with native species for space and food (Frésard and Boncoeur, 2006; Mineur et al., 2012). It may therefore pose a threat to the feature. However, the spread and impact of the species on the feature is not fully understood.

G. vermiculophylla has also been found at Traeth Lafan sandflats within the SAC. This species has the potential to establish quickly in shallow soft-bottomed bays and estuaries as it has broad environmental tolerances (Maggs and Magill, 2014). *G. vermiculophylla* can have a detrimental impact on the feature. The species can alter the sedimentation and topography and could alter the habitat in the long-term if at high densities (Maggs and Magill, 2014).

Five Chinese mitten crabs *Eriocheir sinensis* have been identified in April 2024 near Deganwy marina, including a berried female. A single record was found in 2010 and 2013 but some uncertainties remain to whether the crab specimen was alive suggesting sign of population being there at the time. This is not currently an issue for the feature in the SAC, however, high numbers in the future may have an impact.

Future increases in air and water temperatures that are expected with climate change may result in increased occurrence of conditions suitable for spawning and settlement of *M. gigas*. Northward recruitment may be expected (Smyth et al., 2022).

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. This SAC could be at risk since there are a number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Water quality: contaminants

There is the potential for unregulated contaminants (such as Per- and polyfluoroalkyl substances (PFAS)) to increase. This could affect some of the biota of the mudflats and sandflats feature as PFAS has been shown to bioaccumulate in marine species, increasing up the trophic levels (Khan et al., 2023). However, the biological impact of PFAS on marine species is not well understood.

Some persistent chemicals are not measured in every WFD waterbody, and some of the relevant WFD waterbodies have not been classified for any chemicals.

Management of coastal defences

The State of the UK Climate 2023 Report highlights an observed acceleration in rates of climate induced sea-level rise which, along with storm surges can cause coastal erosion and flooding (Kendon et al, 2024). Shoreline Management Plans identify the preferred approach to coastal management in light of climate change, which includes maintaining or upgrading defences in some areas and adapting the approach to management in others. Where defences continue to be maintained, there are potential impacts on coastal processes and associated habitats and species. Intertidal habitats may also be lost as a result of coastal squeeze (Oaten et al., 2024).

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counter act each other. However, threats from climate change may include (Gihwala et al., 2024 and Oaten et al., 2024):

- Sea level rise, leading to coastal squeeze and loss of extent.
- Changes to wave climate, especially storm frequency and intensity, which may change the topography.
- Changes in air and sea temperature.
- Changes in species distribution.

The latest information (Oaten et al., 2024) shows that mudflats and sandflats in this SAC is definitely under threat of coastal squeeze and natural squeeze (loss of habitat against high ground).

Evidence gaps

There are gaps in the current evidence that NRW feel are needed to be filled to fully understand condition in this feature.

Listed below (Table 4) are current indicators that were either assessed as unknown, not assessed, or assessed with a lower confidence. This was due to either limited data availability, outdated data, or a lack of information. Some indicators are not currently monitored but should be ideally considered in future condition assessments.

Table 4. Evidence gaps for the mudflats and sandflats feature in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see Section 1.1).

Indicator	Assessed status	Comments
Extent (P)	Medium confidence (proxy data used)	• Currently, the extent of mudflats and sandflat is not accurately measured at any of the SACs and there is no repeated measure taken.
Distribution and extent of habitats and communities (P)	Medium confidence (proxy data used)	• Without any recent biotope surveys undertaken, assessing changes in mudflats and sandflats in all SACs is difficult. A new survey is required.
Topography of the feature (P); hydrodynamic and sediment transport processes (P)	Medium confidence (proxy data used)	• The topography and hydrodynamic regime of mudflats and sandflats is not currently monitored in all SACs. • The Wales Coastal Monitoring Centre monitor some sites and are working on a dashboard that will flag up locations with changes outside of natural variability. This could help in assessing in the next cycle of condition assessment.
Sediment quality: organic carbon content (P); contaminants (P).	Not assessed	• Currently, there is no sediment monitoring within the Menai Strait and Conwy Bay SAC.
Invasive non-native species (P)	Low confidence (limited data)	• The spread and impact of the NNS currently present within the SAC on the mudflats and sandflats feature is not fully understood. More targeted surveys and investigation on the impact of NNS on mudflats and sandflats are needed. • Investigation into the use of satellite and or aerial imagery for assessing the extent of *G. vermiculophylla* may be beneficial.
Sediment quality: oxidation-reduction profile (redox layer) (S)	Low confidence (limited data)	• The redox layer of sediments was based on current monitoring, but the short time range and small spatial coverage available meant it was difficult to confirm any trend. A larger spatio-temporal dataset is required to fully understand what is happening.

Indicator	Assessed status	Comments
Sediment quality: dissolved oxygen (S)	Not assessed	• Dissolved oxygen in sediments is not currently monitored in the mudflats and sandflats feature across Welsh SACs, but there is potential for this to be incorporated into granulometric analysis in future.
Water quality: turbidity (S)	Unknown	• Turbidity is measured in WFD sampling. As this is limited to only a few samples per year it cannot be used to adequately assess the turbidity. • Investigation of the use of remote sensing data to assess turbidity could be carried out in the future. External data from other organisations could also be used.
Water quality: physicochemical properties (S)	Unknown	• Further evidence on temperature change is required to adequately assess this indicator. Some physicochemical parameters such as salinity and pH have not been assessed. These could be considered in future as some monitoring data are available. • Remote sensing data on temperature, salinity and pH could be used in future.

3.2. Reefs condition assessment

Intertidal reefs

The reefs feature in the Menai Strait and Conwy Bay SAC comprises a number of intertidal reefs (Figure 3). The NRW Habitats Regulations monitoring for intertidal reefs has focused on sampling sites within the tide-swept boulder communities at Britannia Bridge and Felinheli, and the tide-swept *Fucus serratus* communities in Brynsiencyn (Llanidan and Castell Gwylan sites). While some of the locations are just outside the SAC boundary they are deemed to be representative of intertidal reefs. These locations were surveyed between 2007 and 2022.

Figure 3. Map of the intertidal reefs in Menai Strait and Conwy Bay SAC.
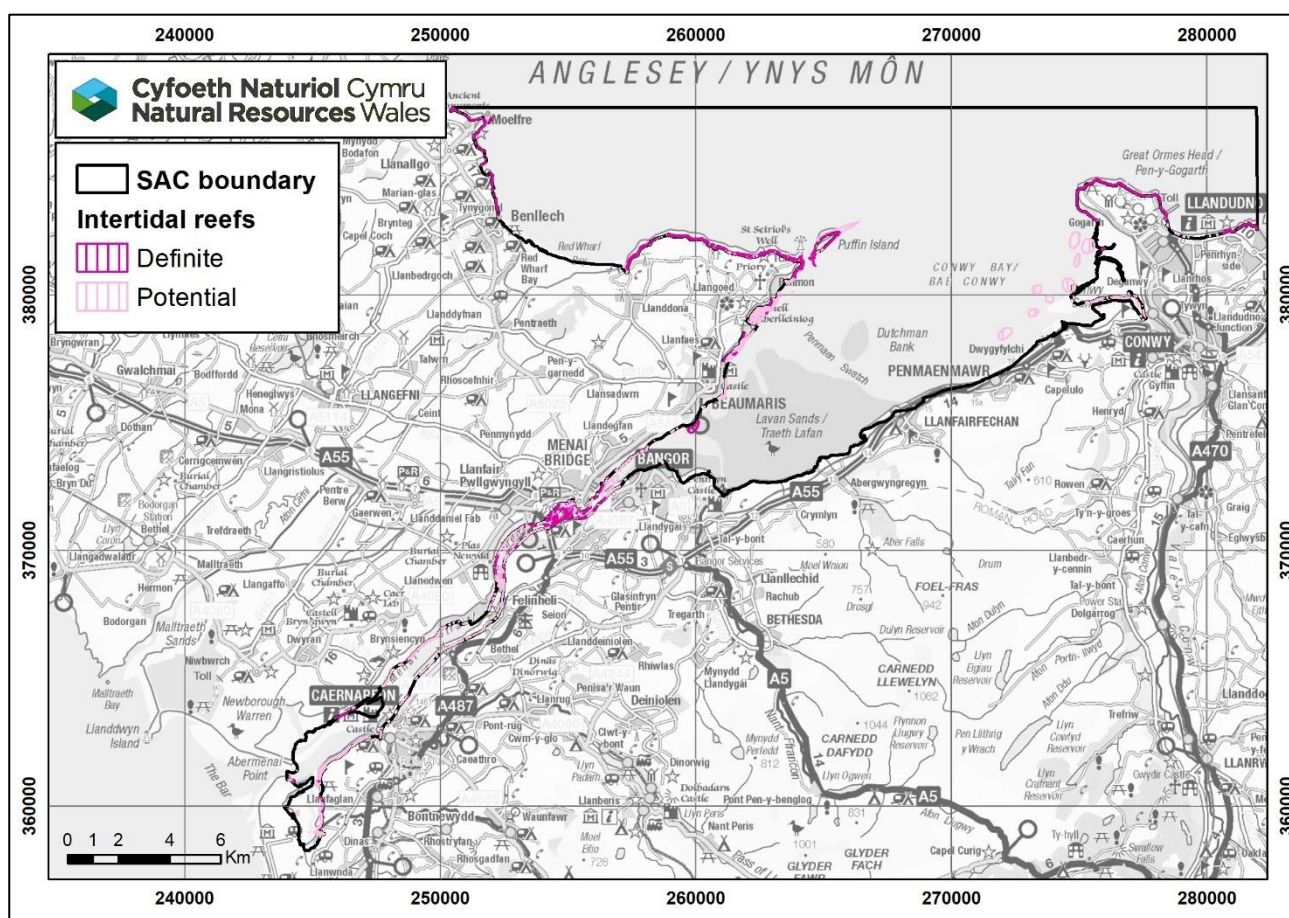
The summary of the assessment outcome for intertidal reefs is provided in Table 5. These outcomes and reasons for failure are discussed in more detail in the sections below.

Table 5. Condition assessment of intertidal reefs in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see Section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Extent	No significant decrease in the extent of natural reef within the SAC, allowing for natural change and variation. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the extent of intertidal reefs in the Menai Strait and Conwy Bay SAC. • Confidence is medium as the assessment has not been based on comparison mapping of the feature and expert judgment was used.	**Pass**	Medium
Distribution of the feature	Maintain distribution of intertidal reef, allowing for natural change. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the distribution of intertidal reefs in the Menai Strait and Conwy Bay SAC. • Confidence is medium as expert judgement has been used to assess this indicator in the absence of recent data.	**Pass**	Medium
Distribution and extent of habitats and communities	Maintain the distribution and extent of reef habitats and communities, allowing for natural change and variation. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the distribution and extent of habitats and communities of intertidal reefs in the Menai Strait and Conwy Bay SAC. • Confidence is medium as expert judgement has been used to assess this indicator in the absence of recent data.	**Pass**	Medium
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of the reef(s). (S)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of intertidal reefs at this SAC. • Confidence is medium as expert judgement has been used to assess this indicator in the absence of recent data.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Bathymetry of the feature	Maintain bathymetry of the reef(s), allowing for natural change and variation. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the bathymetry of intertidal reefs at this SAC. • Confidence is medium as expert judgement has been used to assess this indicator in the absence of recent data.	**Pass**	Medium
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity, allowing for natural variation and change. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the hydrodynamic and sediment transport processes of intertidal reefs at this SAC. • Confidence is medium as expert judgement has been used to assess this indicator in the absence of recent data.	**Pass**	Medium
Water quality: nutrients (DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• One of the seven WFD waterbodies that overlaps with intertidal reefs was not classified for DIN in the 2024 cycle 3 interim classification (Anglesey North). It overlaps with a small proportion of intertidal reefs (7%). • The other six WFD waterbodies have been classified as Good or High status for DIN (Conwy Bay, Menai Strait, North Wales, Conwy, Foryd Bay and Seiont). Combined, these overlap with 88% of intertidal reefs. • Confidence is medium due to the one unclassified waterbody.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: phytoplankton	The WFD classification achieved for phytoplankton should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• One of the seven WFD waterbodies was classified with a Moderate status for phytoplankton in the 2024 cycle 3 interim classification (North Wales). However, it overlaps with 2% of intertidal reefs. • Two WFD waterbodies have not been classified for phytoplankton (Anglesey North and Seiont). These overlap with 7% and <1% of intertidal reefs. • The other four WFD waterbodies were classified as Good or High status for phytoplankton (Conwy Bay, Menai Strait, Conwy and Foryd Bay). Combined, these overlap with 86% of intertidal reefs. Two of these waterbody classifications were rolled forward from previous cycles. • Confidence is low due to the failure of one waterbody, unclassified waterbodies and rolled forward classifications.	**Pass**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: opportunistic macroalgae	The WFD classification achieved for opportunistic macroalgae should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• Four of the seven overlapping WFD waterbodies have not been classified for opportunistic macroalgae in the 2024 cycle 3 interim classification. These overlap with 90% of intertidal reefs. • The other three WFD waterbodies were classified with a Good or High status for opportunistic macroalgae (Conwy, Foryd Bay and Seiont). Combined, these overlap with 5% of intertidal reefs. 　○ There have been observations of nuisance algae in watercourses that feed into the Foryd Bay waterbody. This waterbody classification was rolled forward from the 2018 cycle 2 interim classification. • Confidence is low as the waterbodies classified in the 2024 cycle 3 interim assessment overlap with small proportion of intertidal reefs.	**Pass**	Low
Water quality: dissolved oxygen	The WFD classification achieved for dissolved oxygen should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• One of the seven WFD waterbodies that overlaps with intertidal reefs was not classified for dissolved oxygen in the 2024 cycle 3 interim classification (Seiont). • The other six WFD waterbodies were classified with a High status for dissolved oxygen. 　○ One of these classifications was rolled forward from the 2021 cycle 3 classification (Anglesey North). • Confidence is medium due to samples being taken from the surface of the waterbody.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: contaminants	Water column contaminants not to exceed the EQS. (S)	• One of the seven overlapping WFD waterbodies was not classified as the chemicals have not been assessed within the last six years (Seiont). It overlaps with <1% of intertidal reefs. • Two of the seven WFD waterbodies have a pass for chemicals in the 2024 cycle 3 interim classification (Menai Strait and North Wales). In both waterbodies the classifications were rolled forward from previous cycles. Combined, these waterbodies overlap with 82% of intertidal reefs. • The other four WFD waterbodies that overlap with intertidal reefs have a fail for chemicals in the 2024 cycle 3 interim classification (Anglesey North, Foryd Bay, Conwy and Conwy Bay). These waterbodies failed for contaminants including mercury, PBDE, PAH and cypermethrin. Combined, these waterbodies overlap with 12% of intertidal reefs. • Confidence is medium as the failing waterbodies overlap with a small proportion of the feature; the human health standard has been used for PBDE; and some chemical classifications were rolled forward.	**Fail**	Medium
Water quality: turbidity	Maintain expected levels of turbidity, allowing for natural change and variation. (S)	• There are limited data on turbidity for the reefs feature in the Menai Strait and Conwy Bay SAC, therefore this target was assessed as unknown.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: physicochemical properties	Maintain expected physicochemical properties of the water, allowing for natural change and variation. (S)	• Data from subtidal temperature loggers from within the SAC were available. Loggers at one monitoring site indicated a potential increase in temperature in recent years. It is not clear if this is a localised change or in line with global trends. • An external report from Bangor University indicates that annual mean sea surface temperature is gradually rising in their Menai Strait temperature logger data. • It is not understood if the observed increases in temperature are localised to the SAC, or if they are consistent with the effects of climate change. • This indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Abundance, distribution and species composition of communities	Maintain the abundance, distribution, and diversity of species within communities and component habitats, allowing for natural change and variation. (P)	• Analysis of the tide-swept boulder communities data showed a decrease of *Fucus serratus* by almost a third at both monitoring sites between 2010 and 2019. No local anthropogenic causes have been identified. • There was some changes in tide-swept boulder communities from 2007 to 2013. However, these were within the expected levels of natural fluctuation. Then, from 2014 to 2022, the tide-swept boulder communities have been more stable. • Analysis of the tide-swept *F. serratus* communities data showed the epibiota assemblage to be very variable in both time and space. These changes do not indicate any trends of concern. • Confidence is medium due to the unexplained decrease of *F. serratus* in the boulder communities, and the concern on impacts of boulder turning and bait collection at the Felinheli monitoring site. • Additionally, the sampling areas that the assessment is based upon overlap with a small proportion of the feature.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Species richness and diversity	Maintain the expected richness and diversity of reef species, allowing for natural change and variation. (S)	• Analysis of the tide-swept *F. serratus* communities data showed that species richness decreased at the Felinheli site between 2015 and 2019, and at the Llanidan site in 2018. The richness at both sites subsequently increased again in 2021 and 2022, but not to levels observed previously. • Analysis of the tide-swept boulder communities data indicated no clear temporal trends in species richness. • There were no clear patterns outside of natural change and variation that is expected. • Confidence is medium due to concerns about the low species richness at Felinheli site.	**Pass**	Medium
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities should not adversely affect the condition of the feature. (P)	• There is limited evidence to suggest that INNS (e.g. *Crepidula fornicata*) are currently impacting the condition of intertidal reefs in the SAC. • Confidence is low as the spread and impacts of INNS present within the feature are not well understood.	**Pass**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• *C. fornicata* became established around 2019 in the Menai Strait and numbers are increasing substantially within the reefs feature. • Other NNS have been recorded previously in the Menai Strait within the reefs feature including: *Ostrea chilensis, Magallana gigas* and *Sargassum muticum*. • There have been targeted NNS surveys at intertidal reef sites as part of the MarClim project, 'Rapid Assessment Survey' of marinas and ad-hoc records from the NRW Habitat Regulation monitoring. • Confidence is high due to the arrival of NNS within the last six years, and good availability of records	**Fail**	High

Subtidal reefs

The reefs feature in the Menai Strait and Conwy Bay SAC comprises a number of subtidal reefs (Figure 4). The monitored subtidal reefs include sampling sites within the limestone communities at Ynys Moelfre and Bottle Rock (situated off the Southern end of Puffin Island) and the tide-swept sponge communities at the Coleg Normal and Nelson's Column monitoring sites in the Menai Strait. These locations were surveyed between 2005 and 2023.

Figure 4. Map of the subtidal reefs in Menai Strait and Conwy Bay SAC.
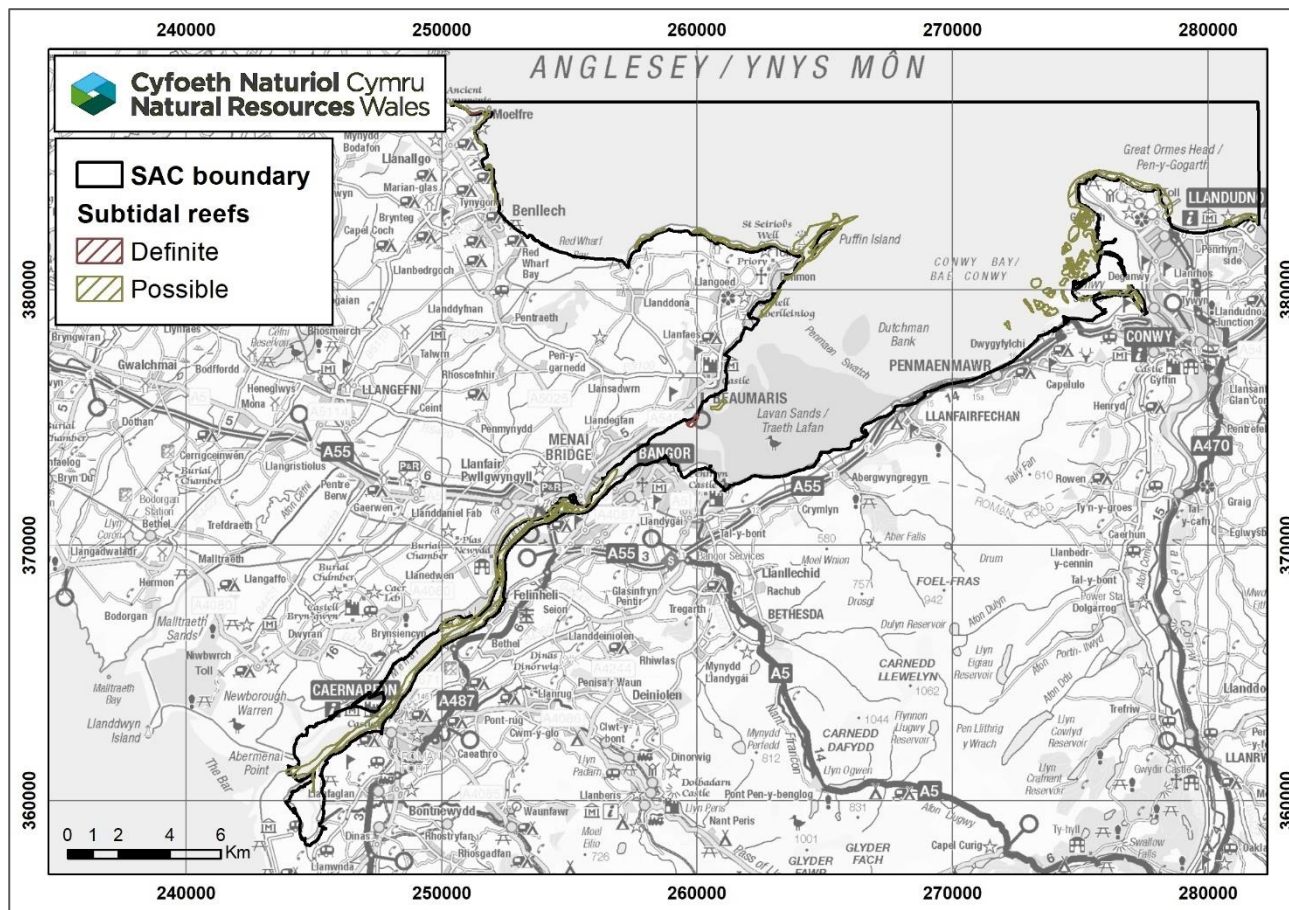
The summary of the assessment outcome for subtidal reefs is provided in Table 6. These outcomes and reasons for failure are discussed in more detail in the sections below.

Table 6. Condition assessment of subtidal reefs in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see Section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Extent	No significant decrease in the extent of natural reef within the SAC, allowing for natural change and variation. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the extent of subtidal reefs in the Menai Strait and Conwy Bay SAC. • Confidence is medium as the assessment has not been based on comparison mapping of the feature and expert judgment was used.	**Pass**	Medium
Distribution of the feature	Maintain distribution of subtidal reef, allowing for natural change. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the distribution of subtidal reefs in the Menai Strait and Conwy Bay SAC. • Confidence is medium as expert judgement has been used to assess this indicator in the absence of recent data.	**Pass**	Medium
Distribution and extent of habitats and communities	Maintain the distribution and extent of reef habitats and communities, allowing for natural change and variation. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the distribution and extent of habitats and communities of subtidal reefs in the Menai Strait and Conwy Bay SAC. • Confidence is medium as expert judgement has been used to assess this indicator in the absence of recent data.	**Pass**	Medium
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of the reef(s). (S)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of subtidal reefs in this SAC. • Confidence is medium as expert judgement has been used to assess this in the absence of recent data.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Bathymetry of the feature	Maintain bathymetry of the reef(s), allowing for natural change and variation. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the bathymetry of subtidal reefs in this SAC. • Confidence is medium as expert judgement has been used to assess this in the absence of recent data.	**Pass**	Medium
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity, allowing for natural variation and change. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the hydrodynamic and sediment transport processes of subtidal reefs in this SAC. • Confidence is medium as expert judgement has been used to assess this in the absence of recent data.	**Pass**	Medium
Water quality: nutrients (DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• One of the six WFD waterbodies that overlaps with subtidal reefs was not classified for the DIN WFD element in the 2024 cycle 3 interim classification (Anglesey North). It overlaps with 17% of the subtidal reefs. • The other five WFD waterbodies were classified as Good or High status for DIN (Conwy Bay, Menai Strait, North Wales, Conwy and Foryd Bay). Combined, these overlap with 83% of subtidal reefs. • Confidence is medium due to the one unclassified waterbody.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: phytoplankton	The WFD classification achieved for phytoplankton should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• One of the six WFD waterbodies was classified with a Moderate status for phytoplankton in the 2024 cycle 3 interim classification (North Wales). It overlaps with 11% of subtidal reefs. The failure of this waterbody was considered unlikely to have a significant effect on the feature, especially as the sample locations were not close to the reefs feature. • One WFD waterbody was not classified for phytoplankton (Anglesey North). It overlaps with 17% of subtidal reefs. • The other four WFD waterbodies were classified as Good or High status for phytoplankton (Conwy Bay, Menai Strait, Conwy and Foryd Bay). Combined, these overlap with 72% of subtidal reefs. Two of the waterbody classifications were rolled forward from previous cycles. • Confidence is low due to the failure of one waterbody, one unclassified waterbody and rolled forward classifications.	**Pass**	Low
Water quality: dissolved oxygen	The WFD classification achieved for dissolved oxygen should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• All six WFD waterbodies that overlap with subtidal reefs were classified with a High status for dissolved oxygen in the 2024 cycle 3 interim classification. o One of these classifications was rolled forward from the 2021 cycle 3 classification (Anglesey North). • Confidence is medium due to samples being taken from the surface of the waterbody, and due to the rolled forward classification in one waterbody.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: contaminants	Water column contaminants not to exceed the EQS. (S)	• Two of the six WFD waterbodies that overlap with subtidal reefs have a pass for chemicals in the 2024 cycle 3 interim classification (Menai Strait and North Wales). In both waterbodies the classifications were rolled forward from previous cycles as they were not classified in the 2024 cycle 3 interim classification. Combined, these waterbodies overlap with 63% of subtidal reefs. • The other four WFD waterbodies have a fail for chemicals in the 2024 cycle 3 interim classification (Anglesey North, Conwy Bay, Conwy and Foryd Bay). These waterbodies failed for contaminants including mercury, PBDE, PAH and cypermethrin. Combined, these waterbodies overlap with 36% of subtidal reefs. • Confidence is medium as the human health standard has been used for PBDE and due to the rolled forward classifications.	**Fail**	Medium
Water quality: turbidity	Maintain expected levels of turbidity, allowing for natural change and variation. (S)	• There are limited data on turbidity for the reefs feature in the Menai Strait and Conwy Bay SAC, therefore this target was assessed as unknown.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: physicochemical properties	Maintain expected physicochemical properties of the water, allowing for natural change and variation. (S)	• Data from subtidal temperature loggers from within the SAC were available. Loggers at one monitoring site indicated a potential increase in temperature in recent years. It is not clear if this is a localised change or in line with global trends. • An external report from Bangor University indicates that annual mean sea surface temperature is gradually rising in their Menai Strait temperature logger data. • It is not understood if the observed increases in temperature are localised to the SAC, or if they are consistent with the effects of climate change. • This indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).	**Unknown**	N/A
Abundance, distribution and species composition of communities	Maintain the abundance, distribution, and diversity of species within communities and component habitats, allowing for natural change and variation. (P)	• Analysis of subtidal reefs at Ynys Moelfre and Puffin Island indicated stable communities across the monitoring period (2014-2023), with some natural variation. • The sponge morphology data from Ynys Moelfre and Puffin Island did not indicate concern. • The sponge monitoring data from the Coleg Normal monitoring site in the Menai Strait showed a large decline since 2004 which exceeds that expected from natural variation. This caused the indicator to fail its target. An NRW led investigation is ongoing to understand the reasons for this decline. • Confidence is high due to the availability of long term monitoring data and the large decline seen in sponge.	**Fail**	High

Indicator	Target	Assessment rationale	Target assessment	Target confidence

Species richness and diversity	Maintain the expected richness and diversity of reef species, allowing for natural change and variation. (S)	• At Puffin Island, the recorded changes in species richness and abundance from the analysis of the subtidal reef communities data were small and considered to be natural.
		• Diversity for the sponge morphology data at Ynys Moelfre and Puffin Island appeared stable across time.
		• Data analysis of the Ynys Moelfre and Coleg Normal monitoring sites sponge communities indicate reductions in species richness.
		    o At Yyns Moelfre, there has been a 20% decline in reef-associated species richness.
		    o The decline in the sponge community at Coleg Normal has led to a decrease in species richness.
		• Confidence is medium as no change in species richness was detected at Puffin Island, and due to the time-limited nature of the sampling methods.
			Fail	Medium

Taxonomic spread of species	Maintain the expected taxonomic spread of reef species, allowing for natural change and variation. (S)	• Overall, the average taxonomic distinctness of the monitored subtidal reefs at Puffin Island remained stable and within the expected values between 2014-2023. • The average taxonomic distinctness at the lower circalittoral zone at Ynys Moelfre was lower in recent years and a reduced number of species was observed. This caused the indicator to fail. • Confidence is low as the analysis is based on data collected in 2014, 2016, 2022 and 2023, making any inference difficult.	**Fail**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities should not adversely affect the condition of the feature. (P)	• There is limited evidence to suggest that INNS (e.g. *Crepidula fornicata*) are currently impacting the condition of subtidal reefs in the SAC. • Confidence is low as the spread and impacts of the INNS present within the feature are not well understood.	**Pass**	Low
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• *C. fornicata* became established around 2019 in the Menai Strait and numbers are increasing substantially within reefs feature. • Other NNS have been recorded previously in the Menai Strait within the reefs feature including: *Ostrea chilensis, Magallana gigas* and *Sargassum muticum*. • There have been targeted NNS surveys at intertidal reef sites as part of the MarClim project, 'Rapid Assessment Survey' of marinas and ad-hoc records from the NRW Habitat Regulation monitoring. • Confidence is high due to the arrival of NNS within the last six years, and good availability of records.	**Fail**	High

Assessment conclusions

The reefs feature in Menai Strait and Conwy Bay SAC has been assessed as being in **unfavourable** condition (medium confidence). There were a number of failing targets (Table 7). There were limited or no data available for some key indicators to inform on the condition of the feature (see evidence gaps). This has contributed to the reduced confidence in the overall conclusion. Further investigation is needed to better understand all of the failures to be able to identify management options that can bring the feature back into favourable condition. A summary of the assessment can be seen in Table 7 with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 7. Summary of the condition assessment for reefs in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

Feature	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Reefs	**Unfavourable (medium confidence)**	Abundance, distribution and species composition of communities (P) Water quality: contaminants (S) Species richness and diversity (S) Taxonomic spread of species (S) Non-native species (T)	• Sponges at the Coleg Normal subtidal reefs site are in decline. This has led to a decline in species richness. There was also a 20% decrease in species richness in Ynys Moelfre. • Levels of mercury, PBDE, PAH and cypermethrin in the Anglesey North, Foryd Bay, Conwy Bay and Conwy waterbodies are failing to meet their relevant EQS. • Taxonomic distinctness of epibiota has declined in the Ynys Moelfre subtidal reef site. • *C. fornicata* became established around 2019 in the Menai Strait and numbers are increasing substantially.	• Unconsented infrastructure • Recreational access and collection • INNS • Water quality: contaminants • Management of coastal defences • Climate change

Detailed assessment information

Extent and Distribution

The extent, distribution of the feature, and the distribution and extent of habitats and communities indicators in the Menai Strait and Conwy Bay SAC passed their targets as there are currently no known anthropogenic impacts that would negatively affect the reefs feature. This applies to both intertidal and subtidal reefs. Comparison mapping has not been used to assess the extent and expert judgment was used to assess these indicators in the absence of recent data. This has reduced the confidence to medium.

Sediment and Topography

The sediment quality indicators are relevant to subtidal reefs only. There were no data available on sediment quality within the SAC therefore these indicators were not assessed.

The topography, bathymetry, hydrodynamic and sediment transport processes are not well researched for reefs. These targets passed with medium confidence based on the knowledge that there are currently no anthropogenic activities that are known to have a significant impact on intertidal and subtidal reefs.

Water quality

It has been estimated that approximately 95% of intertidal reefs and nearly 100% of subtidal reefs within the SAC fall within seven WFD waterbodies. These are therefore likely to be a good reflection of the overall effect of water quality on the feature. The Menai Strait waterbody overlaps with a large proportion of intertidal and subtidal reefs in the SAC (Table 8). For subtidal reefs, the Anglesey North, Conwy Bay and North Wales waterbodies overlap with a smaller but significant proportion (Table 8). The Seiont waterbody overlaps with a very small proportion of intertidal reefs and none of the subtidal reefs (Table 8), and has therefore not been considered further in the condition assessment. Foryd Bay waterbody was not considered further in the assessment of subtidal reefs for the same reason.

Table 8. WFD waterbodies that overlap with intertidal and subtidal reefs within the Menai Strait and Conwy Bay SAC.

WFD waterbody	Degree of overlap with intertidal reefs (%)	Degree of overlap with subtidal reefs (%)
Menai Strait	80.61	52.23
Anglesey North	6.83	16.71
Conwy Bay	0.48	13.30
North Wales	1.70	11.12
Conwy	1.54	6.30
Foryd Bay	3.46	0.17
Seiont	0.07	0.00
All waterbodies combined	94.69	99.83

Nutrients (DIN only), phytoplankton and opportunistic macroalgae

The indicators for nutrients and phytoplankton met their targets. The confidence in the pass for the nutrients indicator was medium because one WFD waterbody was not classified for the DIN element in the 2024 cycle 3 interim classification. The confidence in the pass for the phytoplankton indicator was reduced to low because the High status classifications for two WFD waterbodies were rolled forward. This includes the Menai Strait waterbody, which overlaps with a large proportion of the feature (Table 8). In addition, one WFD waterbody (North Wales) was classified as Moderate status, but overlaps with a comparatively smaller proportion (Table 8). It was deemed that the failure of this waterbody was unlikely to have a significant effect on the feature, especially as the sample locations were not close to the reefs feature. Two WFD waterbodies were not classified for the phytoplankton element. Classification of some WFD waterbodies are not suitable or possible for this element due to WFD classification methodology, or due to the nature of the waterbodies (e.g. turbidity levels).

The opportunistic macroalgae indicator met its target as three of the overlapping WFD waterbodies were classified as Good or High status for this element in the 2024 cycle 3 interim classification (Foryd Bay, Conwy and Seiont). Combined, these waterbodies overlap with a small proportion of the feature (5%), and the classification for one of these was rolled forward from the 2018 cycle 2 interim classification. This reduced the confidence in the pass. There have been observations of nuisance algae in the watercourses that feed into the Foryd Bay waterbody, therefore sampling may not be suitable to pick up issues and this could be something to investigate in future. However, as this waterbody overlaps with a small proportion of the feature (Table 8), this observation did not lead to a failure. The other four WFD waterbodies were not classified for this element in the 2024 cycle 3 interim classification. This includes the Menai Strait waterbody, which overlaps with the largest proportion of intertidal reefs (Table 8). Some waterbodies are not assessed for opportunistic macroalgae as they do not have suitable substratum (i.e. areas of intertidal habitat for opportunistic macroalgal growth). The confidence in the pass was reduced to low because a large proportion of intertidal reefs overlap with waterbodies that have not been classified for the opportunistic macroalgae element. This indicator is not relevant to subtidal reefs.

Dissolved oxygen

The dissolved oxygen indicator also met its target as nearly all relevant WFD waterbodies were classified with a High status for the dissolved oxygen element in the 2024 cycle 3 interim classification. The dissolved oxygen samples are taken at the water's surface. By the time oxygen depletion at the surface is recorded, oxygen throughout the water column could have been depleted for some time, especially as hypoxia or low oxygen levels, when present, typically occur in bottom water and sediments. Therefore, surface sampling of dissolved oxygen may not detect issues for more demersal features. This, and as there was one WFD waterbody with a rolled forward classification, reduced the confidence in the pass to medium.

Contaminants

Four of the seven WFD waterbodies that overlap with the intertidal and subtidal reefs in the SAC have a fail for chemicals in the 2024 cycle 3 interim classification. This caused the contaminants indicator to fail for both subtidal and intertidal reefs. Combined, these four

WFD waterbodies overlap with approximately 12% of intertidal reefs and 36% of subtidal reefs. The failures were in the Anglesey North (mercury and PBDE), Conwy Bay (PAH), Foryd Bay (mercury), and Conwy (PBDE, mercury, PAH and cypermethrin) waterbodies.

There has been a waterbody status change from pass to fail in the Conwy Bay waterbody between the 2021 cycle 3 classification and the 2024 cycle 3 interim classification, however the failing contaminant (PAH) was not assessed in previous cycles. Similarly, in the Conwy waterbody, two of the failing contaminants (PAH and cypermethrin) were not previously classified. With the exception of the 2021 cycle 3 classification, mercury has failed in this waterbody in all classifications since the 2015 cycle 2 classification. The waterbody status changes for mercury between cycles are likely due to changes in WFD classification methodology. Cypermethrin is a synthetic pyrethroid insecticide and is highly toxic to some aquatic species (EA, 2019), but now has a restricted use in Wales. The EQS for cypermethrin is very low, and in the previous laboratory methodology, it was not possible to detect concentrations below the EQS. There was an additional failure for zinc in the 2021 cycle 3 classification the Conwy waterbody, but this no longer fails in the 2024 cycle 3 interim classification. In the Anglesey North waterbody, mercury has failed since the 2015 cycle 2 classification. The EQS for mercury is based on the secondary poisoning protection goal (for wildlife). The PBDE failures were based on the value of the human health protection goal as it is the most stringent. This protection goal may be over precautionary as the effect of contaminants on the biota of reefs are not fully understood. The confidence in the fail was reduced to medium to reflect this.

The other two overlapping waterbodies (North Wales and Menai Strait) have a pass for chemicals in the 2024 cycle 3 interim classification. However, in both WFD waterbodies the classifications were rolled forward from previous cycles as they were not classified in the 2024 cycle 3 interim classification. The Menai Strait waterbody overlaps with the largest proportion of both intertidal and subtidal reefs. This also contributed to the reduced confidence. In addition, the impact of the failing contaminants on the feature are not fully understood.

Turbidity and physicochemical properties

The turbidity indicator was assessed as unknown due to insufficient data. There were some data available from WFD Regulations sampling of suspended particulate matter. However, this is limited to only a few samples per year and therefore cannot be used to adequately assess the turbidity.

Data from NRW monitored subtidal temperature loggers from two sites within the SAC were available. However, as loggers from one of the monitoring sites had a large amount of missing data, the observed patterns in temperature are based on data from only one monitoring site which does not overlap with the feature but was less than 500m away. These loggers showed an increase in temperature in more recent years. An external report (Smyth et al., 2022) also found that the annual mean sea surface temperature was gradually rising in the Menai Strait. It is not understood if the observed increases in temperature are localised to the SAC, or if they are consistent with the effects of climate change. The physicochemical indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).
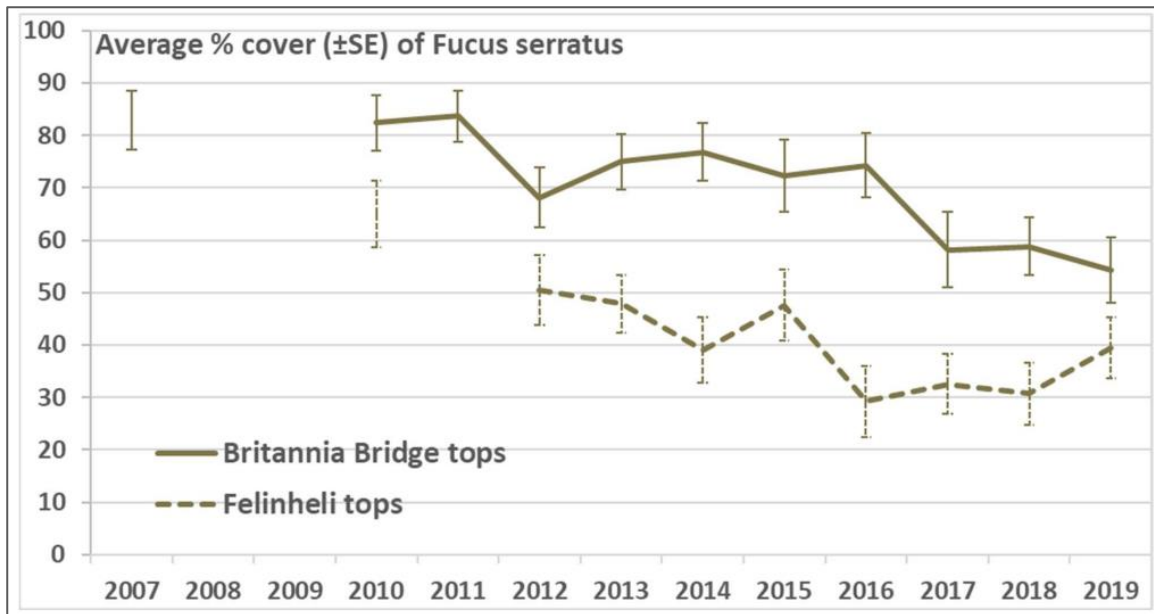
Species and communities

Intertidal reefs

Assessment of the species community indicators for intertidal reefs in Menai Strait and Conwy Bay SAC used data from various monitoring sites. This includes monitoring of sampling sites within the tide-swept boulder communities at Britannia Bridge and Felinheli, and the tide-swept *Fucus serratus* communities in Brynsiencyn (Llanidan and Castell Gwylan sites), from 2007 to 2022. While some of the locations are just outside the SAC boundary they are deemed to be representative of intertidal reefs.

Macrofaunal analysis for the intertidal data showed that there was a change in communities present in the tide-swept boulder locations from 2007 to 2013, with a very similar trajectory at both sites and on both the boulder tops and boulder bottoms. Multiple species contributed to these changes including a decrease in some species of sponges, spirobid, and serpulid worms, barnacles and *F. serratus* and a fluctuation in the abundance of sea squirts (Moore, 2022). However, these changes may have been partly confounded by differing methodological.

From 2014 to 2022, the community has been more stable (Moore, 2022; Moore et al., 2023). These changes appeared to reflect the expected level of natural variation and data analysis indicated that the epibiota assemblage was highly variable in both space and time, but with no reason for concern. However, there has been a decrease in the cover of *F. serratus* by almost a third at both sampling sites between 2010 and 2019 (Figure 5) (Moore, 2022). Interpretation is difficult as boulder selection by the surveyor is inherently influenced by the abundance of *F. serratus.* No local anthropogenic impacts are identified as potential causes for the decline of *F. serratus*. Photographic evidence may indicate that silt levels in 2019 were higher than they were in 2011, but there is no empirical data to confirm this. Another survey focused on the tide swept *F. serratus* communities did not find any notable temporal trends in the overall abundance of *F. serratus*, but its cover was typically patchy at these sampling sites and the number of quadrats surveyed was rarely enough to provide a good estimate of the actual mean (Moore, 2024). Other evidence from the MarClim dataset between 2017 and 2023 suggested that there have been no apparent changes in the SACFOR (Superabundant, Abundant, Common, Frequent, Occasional and Rare) abundance scale of *F. serratus* over this period in all MarClim sites within the SAC (Mieszkowska and Sugden, 2023, 2024). The SACFOR scale is a crude scale to monitor abundance and the decline observed in the boulder surveys may not have been captured by this method. Currently, there is no specific survey designed to monitor the change in abundance of *F. serratus* across the SAC feature. Further investigation is required to understand if the *F. serratus* decline is localised or if it is wider and related to effects of climate change.

Overall, the abundance, distribution and species composition of communities indicator was assessed as passing. The confidence was reduced to medium due to the observed decline in *F. serratus* at the two tide-swept boulder community monitoring sites, and because the sampling areas that the assessment is based upon cover a small proportion of the SAC feature. In addition, there were some concerns raised about the impacts of boulder turning and bait collection on the reef in the Felinheli site.

Figure 5. Average percentage cover (± standard error) of *Fucus serratus*. Each point is calculated from a minimum of 25 boulders (Moore, 2022).

In general, species richness tended to be higher at Britannia Bridge than Felinheli sites for the tide-swept boulder communities (Moore, 2022; 2024). The total number of taxa reduced at the Felinheli site between 2015 and 2019, then rose again in 2022, but not to levels observed previously. An large reduction in species richness at Britannia Bridge was observed between 2018 and 2019. This was mainly due to the reduced numbers of sponge taxa (Moore, 2022). Data from 2021 and 2022 show a large increase in the number of species of sponges, but not to previous levels. There was also a decrease in species richness for the *F. serratus* communities at Llanidan monitoring site up to 2019, however it has increased again in recent years (e.g. 2021 and 2022) suggesting natural fluctuations. Overall, there were no clear temporal trends in species richness for intertidal reefs, and changes tended to be within the bounds of natural variation, resulting in a pass for this indicator. However, there is some concern about the low species richness at Felinheli site, and the unexplained reduction in species richness of sponges at Britannia Bridge in 2018, resulting in medium confidence.

The taxonomic spread of species indicator for intertidal reefs could not be assessed due to insufficient data.

Subtidal reefs

The subtidal reefs assessment included data from various monitoring sites: Ynys Moelfre, situated in the northeast of the Menai Strait and Conwy Bay SAC; Bottle Rock at the southern tip of Puffin Island and Coleg Normal within the Menai Strait. Abundance of different sponge morphologies, as a proxy for sponge species, was assessed using fixed quadrats at Ynys Moelfre (2005-2023) and Bottle Rock (2011-2023) monitoring sites, whilst more recently from 2014 onwards, a more complete suite of reef-associated species were assessed using the same quadrats at these two monitoring sites. Sponge luxuriance, an estimate of both abundance and volume, was assessed along transects at the Coleg Normal monitoring site from 2004 to 2023.

The subtidal reefs analysis of the monitored sites at Puffin Island and Ynys Moelfre indicated small changes in species composition between 2014 and 2023. Several species contributed to these small changes with no pattern detected. Such fluctuations were judged to be within the bounds of natural variation. The sponge morphology at Ynys Moelfre and Puffin Island monitoring sites varied greatly when analysed individually across the monitoring period with no clear pattern. Despite the variation recorded, the mean morphotypes at both monitoring sites was stable over time and thus was considered to be natural.

However, sponge monitoring data at the Coleg Normal site in the Menai Strait indicated a dramatic decline in sponge biomass since 2004 and recent data suggests no improvement (Figure 6 and Figure 7). Sponge luxuriance is used for assessing the health of the sponge community, which is a notable component of the reef feature. The decline in sponge biomass could be an indicator of wider impacts across the whole reefs feature within the SAC. An NRW led investigation is ongoing to understand the reasons for this decline. This decline has resulted in a fail for the abundance, distribution and species composition of communities indicator with high confidence.

The species richness and diversity indicator failed based on a recent 20% decline in reef-associated species richness recorded at Ynys Moelfre monitoring site. Additionally, the decline in sponges recorded at the Coleg Normal site, specifically the loss of the sponge Mermaid's glove *Haliclona oculata* from transects in recent years, has led to a decrease in species richness and therefore contributed to this failure. The confidence in this assessment was lowered to medium as no change in species richness was detected at Puffin Island monitoring site and due to the time-limited nature of subtidal monitoring methods. Where time-limited methods are used, and the allowed time is not enough to generate a full species list, inter-surveyor differences become more of an issue for the assessment of species richness and diversity. Changes such as improvement of taxonomic expertise, taxonomic nomenclature improvement throughout the monitoring period is likely to further affect species richness and abundance.

The average taxonomic distinctness was deemed to be within the bounds of natural variation for the reef-associated species at Puffin Island monitoring site. A decrease, however, was detected for the lower circalittoral zone at Ynys Moelfre monitoring site, with lower numbers of species found in more recent years. This finding further supports the evidence of declining species richness at this monitoring site. As a result, the taxonomic spread of species indicator has failed to meet its target. The decreasing trend in taxonomic distinctness at Ynys Moelfre monitoring site, needs confirmation with further sampling. The analysis for this indicator was based on only four data points between 2014-2023 and the failure is localised to a small part of the feature, resulting in a lower confidence.

Figure 6. Measurements of the sponge *Haliclona oculata* along Coleg Normal's 30 m southwest transect in the Menai Strait and Conwy Bay SAC during the monitoring period 2004-2023. a) Percentage occurrence (%) and b) mean size (cm).
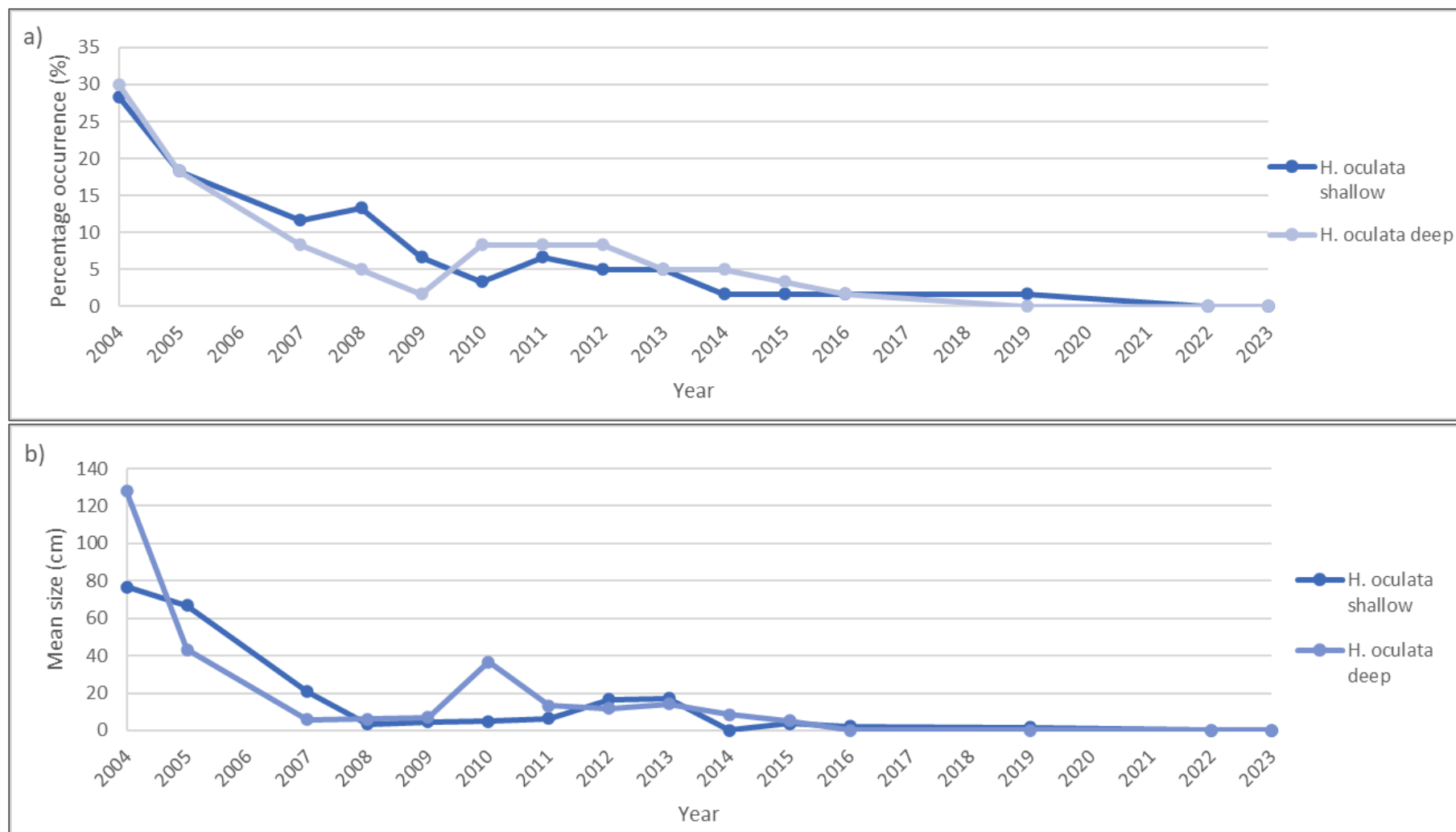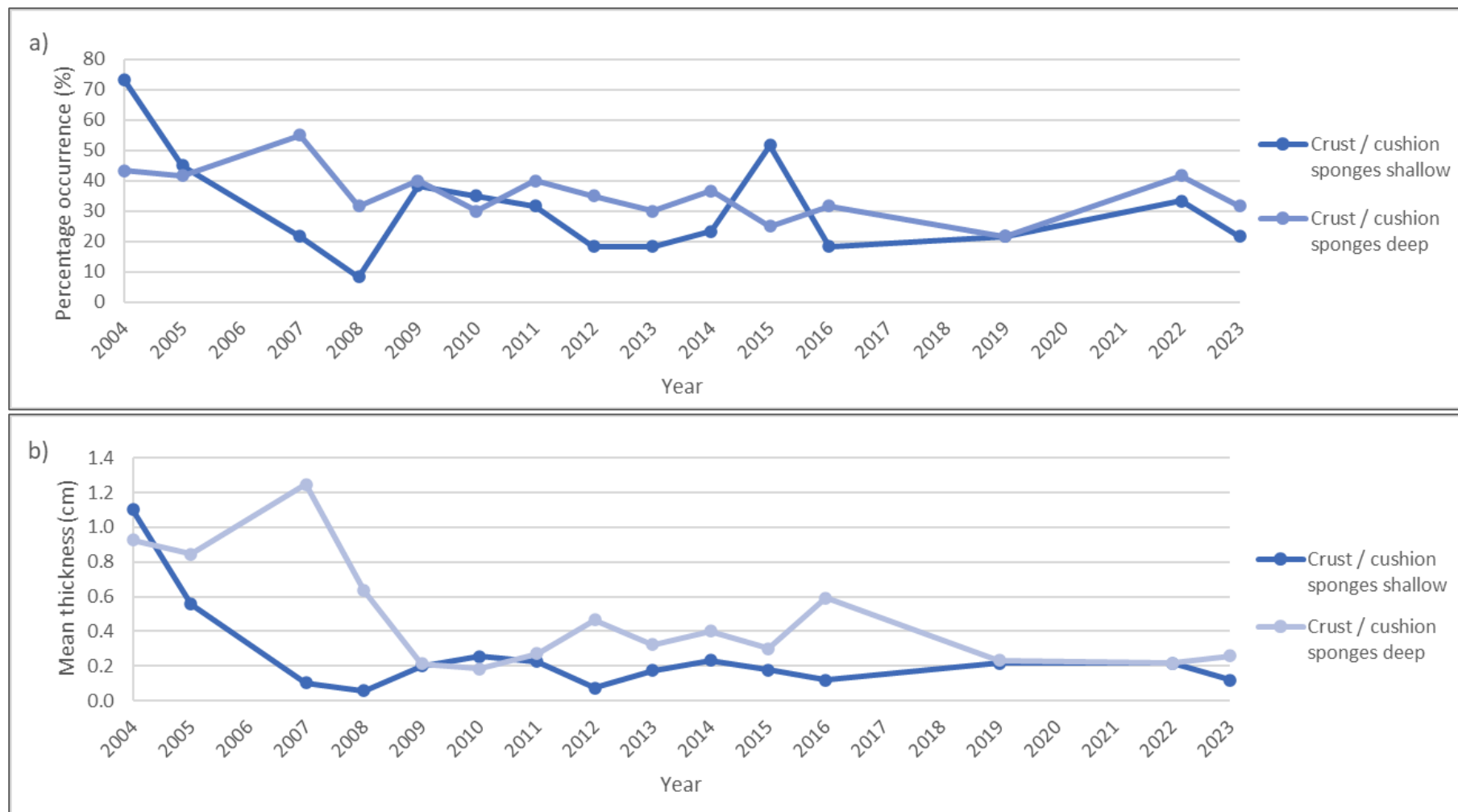
Figure 7. Measurements of crust and cushion sponges along Coleg Normal's 30 m southwest transect in the Menai Strait and Conwy Bay SAC during the monitoring period 2004-2023. a) Percentage occurrence (%) and b) thickness (cm).

Invasive non-native species

There were records of *Crepidula fornicata* identified in 2006 in the Menai Strait, however, following an eradication attempt, no records of the species were identified for a number of years. More recently, within the last six years, this species has become established (i.e. since 2019) within the reefs feature in the Menai Strait, and numbers are increasing. Therefore, the tertiary target of the NNS indicator failed with high confidence due to the new NNS recorded in the reefs feature within the last reporting cycle.

Other NNS are known to be present in the Menai Strait (within the reefs feature) including *Ostrea chilensis, Magallana gigas* and *Sargassum muticum.* Limited records have been produced for *O. chilensis,* but it has been known to be present in the Strait for about 30 years. The cover of *S. muticum* is thought to be extensive in the SAC, however this species is no longer consistently recorded. *S. muticum* has replaced the zone of sugar kelp in some areas in the Menai Strait but it is thought that it has not expanded significantly in recent years.

It is not fully understood how some of these species may impact the reef biota and effects on the species diversity and composition have not yet been observed. As there is no current impact from the INNS present the primary target of the INNS indicator passed. Confidence is low as the spread and impacts of the INNS present within the feature are not well understood.

Reasons for target failure

The assessment of the reefs feature in the Menai Strait and Conwy Bay SAC failed one primary target, three secondary targets and one tertiary targets. This resulted in the feature to be assessed as being in **unfavourable** condition. The failing indicators and reasons for failure, if known, are stated below.

Abundance, distribution and species composition of communities

This indicator target has a primary weighting. The sponge biomass at Coleg Normal monitoring site has dramatically decreased since 2004 and there is no sign of recovery. As sponge luxuriance is a proxy for assessing the health of the subtidal reef habitat, the sponge biomass decline suggest that the wider reefs feature could be affected. This has resulted in a fail for the abundance, distribution and species composition of communities indicator with high confidence. The reason for this decline is not currently known, but an investigation is underway to help understand the cause of decline and to confirm if it is a localised or wider issue.

Water quality: contaminants

This indicator target has a secondary weighting. The reefs feature is partly within four WFD waterbodies (Anglesey North, Foryd Bay, Conwy Bay and Conwy) which have failed for chemicals due to mercury, PBDE, PAH and cypermethrin. Historically, the main source of PBDE is as flame retardants in a variety of materials (Viñas et al., 2022). Mercury has been used in many industries, but today the primary sources are burning of coal and artisan mining for mercury (Larsen and Hjermann, 2022). PAHs can be produced through natural processes, but also arise from anthropogenic sources, for example during

combustion of fossil fuels and organic material (Webster and Fryer, 2022). Cypermethrin is an insecticide used for plant protection in crops, in forestry, gardens, homes and businesses. It is also used in veterinary medicine to control pests in livestock and pets (EA, 2019). The application of cypermethrin has been restricted for some uses (sheep dipping and in forestry against the pine weevil).

Some of the contaminants in the water column may be derived from diffuse sources including atmospheric deposition or contaminated waterbody bed sediments. However, WFD investigations of the failures in all four waterbodies are yet to be undertaken. Mercury and PBDE are being managed in the UK and it is hoped that these levels will reduce in time. There is currently no specific management in place for PAH in Wales. The PAH EQS is based on the most sensitive taxa and may not be applicable to all of the reef biota. The impacts of PAH on the reefs feature are not fully understood.

Species richness and diversity

This indicator target has a secondary weighting. There has been a 20% decline in species richness in reef-associated species at the subtidal reef site, Ynys Moelfre. While no causes have been identified, such decline is concerning and requires further monitoring to know if this is a persistent and localised issue. There has also been a decline in species richness in the subtidal sponge community at Coleg Normal site in the Menai Strait with no sign of recovery.

Taxonomic spread of species

This indicator target has a secondary weighting. A decline in average taxonomic distinctness and in the number of species was observed since 2016 at the lower circalittoral zone of the subtidal reef site, Ynys Moelfre. While the reason for such a decline is unknown, this is concerning and will require further monitoring.

Non-native species

This indicator failed to meet its tertiary target of no increase in the number of introduced NNS by human activities. This is due to the reappearance of *C. fornicata* within the reefs feature in the Menai Strait within the last six years. It is not fully understood how this species, and the other NNS present within the SAC may spread and impact the reef biota, and any negative effects on the species diversity and composition have not yet been observed. For this reason it did not fail the primary target of the INNS indicator. A biosecurity plan for INNS has been developed for the SAC. The objective is to manage the key pathways by which marine INNS are introduced and spread at the SAC level through the use of good biosecurity.

Threats to condition

Part of the condition assessment is to identify threats to the condition of the reefs. A threat is defined as an activity that is currently not impacting condition but has the potential to do so over the next reporting cycle, if activity levels increase or are unmanaged. It is important to identify these threats to be able to put pre-emptive management in place to prevent declines in condition.

Activities that go through licencing and permission process e.g. offshore wind and marine cabling, whereby the impact of the activity on the feature would be assessed have not been included. The threats to the condition of the reefs feature in the Menai Strait and Conwy Bay SAC are stated below.

Unconsented infrastructure

New unconsented infrastructures such as private slipways and coastal defences, modify the coastal environment through changes to micro-topography and hydrodynamics and can lead to loss of the feature extent, and impact to the flora and fauna associated with it.

Recreational access and collection

Access for a variety of recreational and collection activities can have an impact on intertidal reefs including trampling and removal of species. Some bait collectors turn boulders and may neglect to replace them in their original position. This could have a detrimental impact on the boulder communities. If boulders are displaced, the underboulder community faces challenges such as desiccation, predation, and wave action, while the surface layer of seaweed gets smothered by the displaced boulder.

Invasive non-native species

There have been confirmed records of *C. fornicata* within the SAC. At high densities, this species could cause an impact on the feature (see further detail in Section 3.1).

Future increases in air and water temperatures that are expected with climate change may result in increased occurrence of conditions suitable for spawning and settlement of *M. gigas*. Northward recruitment may be expected (Smyth et al., 2022).

S. muticum has replaced the zone of sugar kelp in some areas in the Menai Strait and has recently spread into Bardsey Island.

The various other NNS recorded in the SACs pose a threat but the spread and future impacts on the reefs feature are not understood.

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. The SACs could be at risk since there are a number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Water quality: contaminants

There is the potential for unregulated contaminants (such PFAS) to increase. This could affect some of the biota of the reefs feature as PFAS has been shown to bioaccumulate in marine species, increasing up the trophic levels (Khan et al., 2023). However, the biological impact of PFAS on marine species is not well understood.

Some persistent chemicals are not measured in every WFD waterbody, and some of the relevant WFD waterbodies have not been classified for any chemicals.

Management of coastal defences

The State of the UK Climate 2023 Report highlights an observed acceleration in rates of climate induced sea-level rise which, along with storm surges can cause coastal erosion and flooding (Kendon et al, 2024). Shoreline Management Plans identify the preferred approach to coastal management in light of climate change, which includes maintaining or upgrading defences in some areas and adapting the approach to management in others. Where defences continue to be maintained, there are potential impacts on coastal processes and associated habitats and species. Intertidal habitats may also be lost as a result of coastal squeeze (Oaten et al., 2024).

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counter act each other. However, threats from climate change may include (Gihwala et al., 2024; Oaten et al., 2024):

- Sea level rise, leading to coastal squeeze and loss of extent for some SACs.
- Changes in air and sea temperature.
- Changes in ocean acidification.
- Changes to wave climate, especially storm frequency and intensity.
- Changes in species distribution.
- Potential range expansion in NNS (e.g. grey triggerfish *Balistes capriscus* and *M. gigas*).

Evidence gaps

There are gaps in the current evidence that NRW feel are needed to be filled to fully understand condition in this feature.

Listed below (Table 9) are current indicators that were either assessed as unknown, not assessed, or assessed with a lower confidence. This was due to either limited data availability, outdated data, or a lack of information. Some indicators are not currently monitored but should be ideally considered in future condition assessments.

Table 9. Evidence gaps for the reefs feature in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see Section 1.1).

Indicator	Assessed status	Comments
Feature extent (P); distribution of the feature (P); distribution and extent of habitats and communities (P); topography of the feature (S); bathymetry of the feature (P); hydrodynamic and sediment transport processes (P)	Medium confidence (proxy data used)	• There are currently no temporal data available to assess changes for these indicators for intertidal and subtidal reefs across all SACs, and assessment was based on expert judgment.
Distribution and extent of the naturally present reef types (P)	Not assessed	• There are currently no temporal data on reef types for this SAC.
Invasive non-native species (P)	Low confidence (limited data)	• The spread and impact of the NNS currently present within the SAC on the reefs feature is not fully understood. More targeted surveys and investigation on the impact of NNS on reefs are needed.
Sediment: composition and distribution (S); availability (S); depth (S)	Not assessed	• There is no current monitoring of the sediment composition, availability and depth over reefs within all SACs.
Water quality: opportunistic macroalgae (S)	Low confidence	• Some of the WFD waterbodies that overlap with the feature in the Menai Strait and Conwy Bay SAC were not classified for the opportunistic macroalgae WFD element in the 2024 cycle 3 interim classification. Some WFD waterbodies are not assessed for opportunistic macroalgae as they do not have suitable substratum.

Indicator	Assessed status	Comments
Water quality: turbidity (S)	Unknown	• Turbidity is measured in WFD sampling. As this is limited to only a few samples per year it cannot be used to adequately assess the turbidity. • Investigation of the use of remote sensing data to assess turbidity could be carried out in the future. External data from other organisations could also be used.
Water quality: physicochemical properties (S)	Unknown	• Further evidence on temperature change is required to adequately assess this indicator. Some physicochemical parameters such as salinity and pH have not been assessed. These could be considered in future as some monitoring data are available. • Remote sensing data on temperature, salinity and pH could be used in future.
Taxonomic spread of species (S)	Not assessed	• There are currently no data on the taxonomic distinctness for intertidal reefs in all SACs.
Sediment quality: contaminants (T)	Not assessed	• Currently, there is no sediment monitoring within the Menai Strait and Conwy Bay SAC.

3.3. Sandbanks condition assessment

The sandbanks feature in Menai Strait and Conwy Bay SAC comprises a number of sandbanks (Figure 8). The NRW Habitats Regulations monitoring has focussed on two sandbanks within the SAC, one in Red Wharf Bay and one in Conwy Bay. Both sandbanks have been assessed together against the performance indicators and an overall condition was assigned for the feature.

Figure 8. Map of the sandbanks feature in Menai Strait and Conwy Bay SAC.
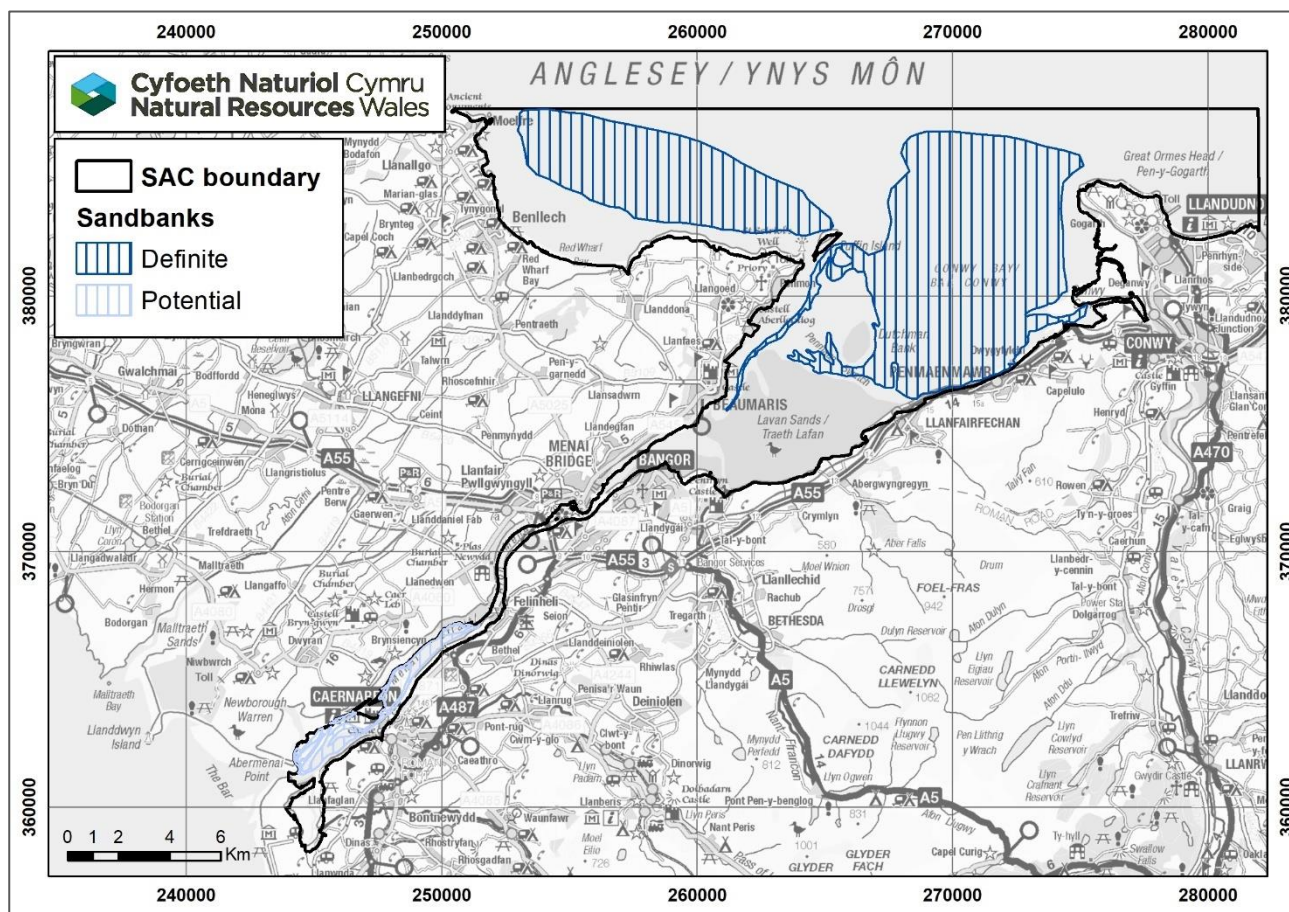
The summary of the assessment outcome is provided in Table 10. These outcomes and reasons of failure are discussed in more detail in the sections below.

Table 10. Condition assessment of sandbanks in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see Section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Extent	No significant decrease in the extent of sandbanks within the SAC, allowing for natural change and variation. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the extent of sandbanks in the Menai Strait and Conwy Bay SAC. • Confidence is medium as the assessment has not been based on comparison mapping of the feature and expert judgment was used.	**Pass**	Medium
Distribution of the feature	Maintain sandbank distribution within the SAC, allowing for natural change and variation. (S)	• There are currently no anthropogenic impacts known to be significantly affecting the distribution of sandbanks in the Menai Strait and Conwy Bay SAC. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Sediment composition and distribution	Maintain composition of sediment granulometry across the sandbanks, allowing for natural change and variation. (P)	• Granulometric analysis from the transect monitoring survey for the two monitored sandbanks showed some changes in sediment composition but these are likely to be natural. • Confidence is medium as the monitoring analysis showed evidence of silt increase in one of the surveillance sites in the Conwy Bay sandbank.	**Pass**	Medium
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of the sandbanks. (P)	• Little change in topography has been observed for both sandbanks in the SAC (~1 m between 1987 and 2019). • Confidence is medium as there is a lot of variability within the data and sparse data points within early surveys have required coarse interpolation.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity, allowing for natural variation and change. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the hydrodynamic and sediment transport processes of sandbanks in the Menai Strait and Conwy Bay SAC. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Water quality: nutrients (DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• Three of the four WFD waterbodies that overlap with the sandbanks feature have been classified as High status for DIN in the 2024 cycle 3 interim classification (Conwy Bay, Menai Strait and Conwy). Combined, these waterbodies overlap with 47% of the feature. • Confidence is medium as one WFD waterbody was not classified for the DIN WFD element (Anglesey North). This waterbody overlaps with 30% of the feature.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: phytoplankton	The WFD classification achieved for phytoplankton should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (T)	• One of the four overlapping WFD waterbodies was not classified for phytoplankton in the 2024 cycle 3 interim classification (Anglesey North). This waterbody overlaps with 30% of the feature. • The other three WFD waterbodies were classified as Good or High status for phytoplankton (Conwy Bay, Menai Strait and Conwy). Combined, these overlap with 47% of the feature. o The Menai Strait waterbody classification has been rolled forward from the 2018 cycle 2 interim classification. • Confidence is medium due to rolled forward classifications; the unclassified waterbody; and as the ecological relationships between phytoplankton and the sandbanks feature are not well understood.	**Pass**	Medium
Water quality: dissolved oxygen	The WFD classification achieved for dissolved oxygen should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• All four WFD waterbodies that overlap with the feature were classified with a High status for dissolved oxygen in the 2024 cycle 3 interim classification. • Confidence is medium due to samples being taken from the surface of the waterbodies, and as one waterbody's classification was rolled forward from the 2021 cycle 3 classification.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: contaminants	Water column contaminants not to exceed the EQS. (S)	• One of the four WFD waterbodies has a pass for chemicals in the 2024 cycle 3 interim classification (Menai Strait). The classification was rolled forward from the 2018 cycle 2 interim classification. This waterbody overlaps with 9% of the feature. • The other three WFD waterbodies have a fail for chemicals (Conwy Bay, Anglesey North and Conwy). Combined, these overlap with 68% of the sandbanks feature. Chemicals that failed were mercury, PBDE, PAH and cypermethrin. • Confidence is medium as the human health standard has been used for PBDE and some waterbodies have rolled forward classifications.	**Fail**	Medium
Water quality: turbidity	Maintain expected levels of turbidity, allowing for natural change and variation. (S)	• There are limited data on turbidity for the sandbanks feature in the Menai Strait and Conwy Bay SAC, therefore this target was assessed as unknown.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: physicochemical properties	Maintain expected physicochemical properties of the water, allowing for natural change and variation. (S)	• Data from subtidal temperature loggers from within the SAC were available. Loggers at one monitoring site indicated a potential increase in temperature in recent years. It is not clear if this is a localised change or in line with global trends. Loggers at the other monitoring site were missing a large amount of data between 2016 and 2021. • An external report from Bangor University indicates that annual mean sea surface temperature is gradually rising in their Menai Strait temperature logger. • It is not understood if the observed increases in temperature are localised to the SAC, or if they are consistent with the effects of climate change. • This indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Abundance, distribution and species composition of communities	Maintain the abundance, distribution, and diversity of species within communities and component habitats, allowing for natural change and variation. (P)	• Three of the four WFD waterbodies were classified as Good or High status for the IQI WFD element in the 2024 cycle 3 interim classification (Anglesey North, Menai Strait and Conwy). Combined, these overlap with 40% of the feature. However, the Conwy Bay waterbody, which overlaps with 38% of the feature was classified with a Moderate status. • Analysis of the transect monitoring data of Red Wharf Bay sandbank (2001-2019) showed that the infaunal communities composition fluctuated with no clear reason. As the pattern is inconsistent with no known anthropogenic impacts, this did not contribute to the failure. • Within the northern part of the Conwy Bay sandbank, the transect monitoring data (2001-2019) showed variations across the sampling period. • Within the middle eastern part of the Conwy Bay sandbank, analysis of SAC/WFD monitoring data in Conwy Bay identified a presence of opportunistic species such as the polychaetes *Lagis koreni, Mediomastus fragilis* and the oligochaete *Tubificoides pseudogaster,* which were dominant over the monitoring period. The presence of these species indicate stressed environmental conditions. • Confidence is medium as the disturbances seen are localised (eastern part of Conwy sandbank) and although the reasons for them are unclear, they are likely to be of anthropogenic origin.	**Fail**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Species richness and diversity	Maintain the expected richness and diversity of sandbank species, allowing for natural change and variation. (S)	• Analysis of the transect monitoring data of the two monitored sandbanks showed an increase of taxa richness for the sandbank in Conwy Bay, and no clear patterns outside of expected natural change and variation for the sandbank in Red Wharf Bay. • Diversity varied with no clear pattern for the sandbank in Red Wharf Bay, and was lower in 2019 for the sandbank in Conwy Bay but only that year. This was not deemed to be a large enough change to fail the target. • Confidence is medium due to small anomalies detected for abundance of species in the 2001-2019 transect monitoring data (in both Red Wharf bay and Conwy Bay sandbanks).	**Pass**	Medium
Taxonomic spread of species	Maintain the expected taxonomic spread of sandbank species, allowing for natural change and variation. (S)	• Overall, the average distinctness of the infaunal community of the two monitored sandbanks remained stable and within the expected values for most of the monitoring period, especially within recent years. • Confidence is high due to the availability of high quality monitoring data and lack of concerning patterns.	**Pass**	High

| Indicator	Target	Assessment rationale	Target assessment	Target confidence
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities should not adversely affect the condition of the feature. (P)	• There is limited evidence to suggest that INNS (e.g. *Crepidula fornicata*) are currently impacting the condition of sandbanks in the SAC. • Confidence is low as the spread and impacts of the INNS present within the feature are not well understood, and there have been no targeted survey of NNS.	**Pass**	Low
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• Two individuals of the American razor clam Jack knife *Ensis leei* were found for the first time at one station in 2019 in the sandbank in Conwy Bay, west of the Great Orme head. • *C. fornicata* became established around 2019 in the Menai Strait and numbers are increasing substantially. Records are within or very close to the Menai Strait sandbanks. • Confidence is high due to the arrival of NNS within the last six years, and good availability of records	**Fail**	High

Assessment conclusions

The sandbanks feature in Menai Strait and Conwy Bay SAC has been assessed as being in **unfavourable** condition (medium confidence). There were a number of failing indicators (Table 11). There were limited or absent data for one key indicator to inform on the condition of the feature (see evidence gaps). This reduced the confidence in the assessment. Further investigation is needed to better understand all of the failures to be able to identify management options that can bring the feature back into favourable condition. As the primary failure was localised, it has been mapped to help focus management effort (Figure 9).

A summary of the assessment can be seen in Table 11 with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 11. Summary of the condition assessment for sandbanks in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

Feature	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Sandbanks	**Unfavourable (medium confidence)**	Abundance, distribution and species composition of communities (P) Water quality: contaminants (S) Non-native species (T)	• There was an IQI failure for Conwy Bay waterbody and localised increase in opportunistic species, indicating stressed environmental conditions (sandbank in Conwy Bay). • Levels of mercury, PBDE and PAH in the Anglesey North and Conwy Bay waterbodies are failing to meet their relevant EQS. • There has been an increase in the number of NNS in the SAC, including *E. leei* and *C. fornicata.*	• INNS • Water quality: contaminants • Climate change

Figure 9. Map of the localised failure in the sandbanks feature in Menai Strait and Conwy Bay SAC.
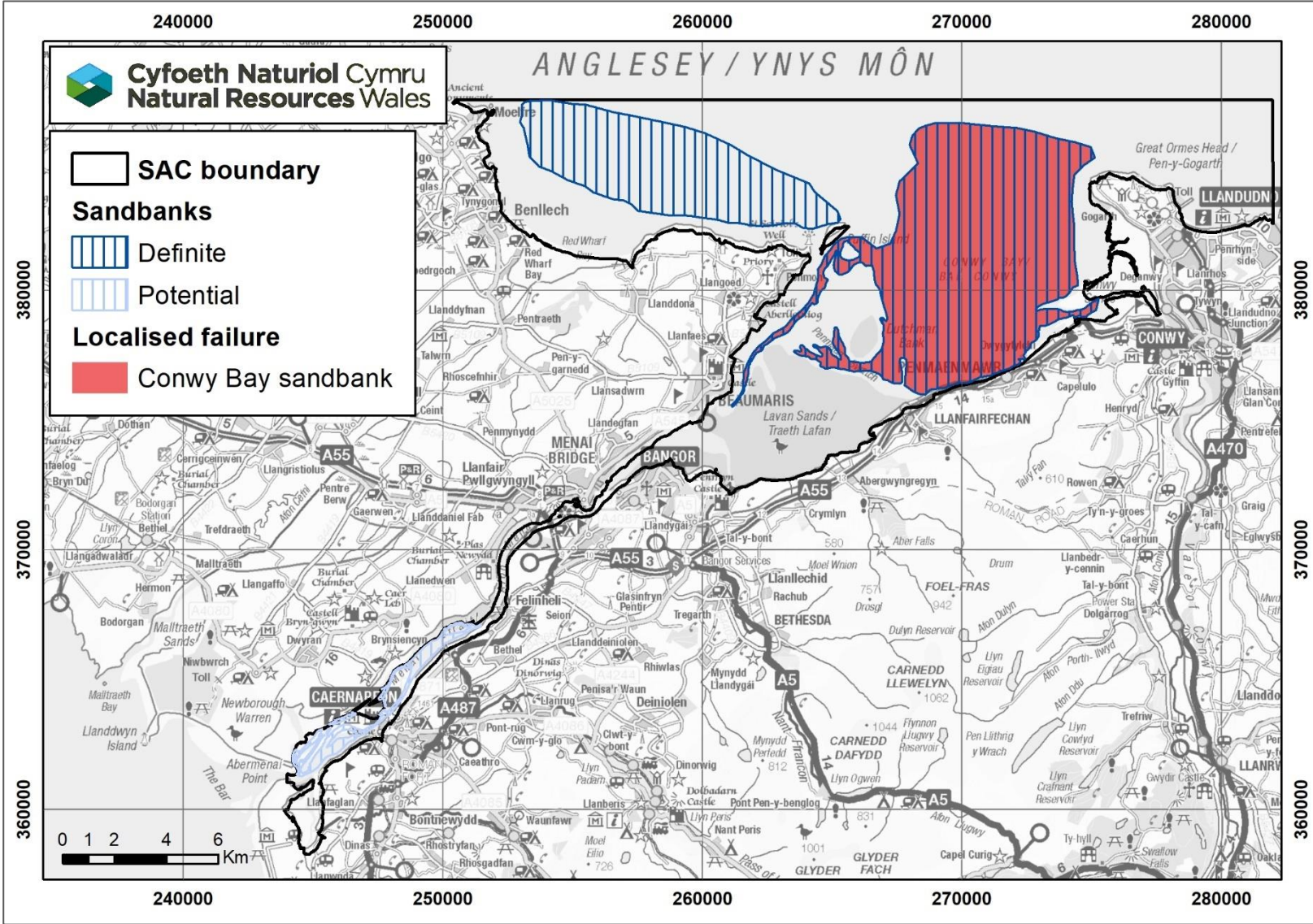
Detailed assessment information

The two monitored sandbanks, which are part of the sandbanks feature in the Menai Strait and Conwy Bay SAC, were monitored in 2001 (five stations) and every three years between 2007-2019. They were assessed using grab sampling as part of the transect monitoring survey with additional monitoring stations from the subtidal soft sediment ecological monitoring for Red Wharf Bay and Conwy Bay.

Extent and distribution

The indicators for extent and distribution of the sandbanks feature in Menai Strait and Conwy Bay SAC pass their targets as there are currently no known anthropogenic impacts that would significantly affect the sandbanks feature. However, the current mapped extent of sandbanks is not highly accurate. Some of the sandbanks within the SAC are located in an area of high tidal flow. As a result, these sandbanks are mobile, have an indistinct topography and vary year by year in extent. Along with the lack of repeat data, the calculation of changes in extent have not been possible. This has reduced the confidence in both indicators to medium. More resources are needed to accurately and regularly map sandbanks using bathymetry techniques.

Sediment, topography and hydrodynamics

Sediment composition varied across the monitoring period. Variation in sediment composition was deemed natural for sandbanks with no known anthropogenic impact that would affect the feature. Analysis of the 2001-2019 transect monitoring data showed that macrofaunal abundance was positively correlated (weak relationship) to the sediment composition for both sandbanks, indicating that communities are to some extent determined by sediment characteristics (NRW unpublished data). Analysis of the data from additional monitoring stations within Conwy Bay, however, showed a notably different sediment composition in 2007 with a greater proportion of sand compared to other years. One surveillance site near the Ormes in Conwy Bay also indicated some signs of disturbance with elevated silt content in later years (Cappelli et al., in draft). This high level of deposition was not deemed sufficient to fail the sediment composition and distribution target but did cause the confidence in the assessment to be reduced to medium. This will require further scrutiny in the next condition assessment.

Analysis of bathymetric data, where available over sandbanks, indicated little change between 1987 and 2019, resulting in a pass for the topography of the feature indicator target. There was an average accretion of 0.35 m (standard deviation 0.43 m) at the sandbank in Conwy Bay, and of 0.54 m (standard deviation 0.44 m) at the sandbank in Red Wharf Bay. There were no clear hotspots or patterns to the change on either bank. The confidence for this outcome is medium due to variation in data collection (single beam vs multibeam) and requirement to interpolate onto a relatively coarse grid for the change calculations.

The hydrodynamic and sediment transport processes are not well researched for sandbanks. This indicator target was met with a medium confidence based on the knowledge that there are currently no anthropogenic activities that are known to have a significant impact on the sandbanks feature in the Menai Strait and Conwy Bay SAC.

Water quality

It has been estimated that approximately 78% of the sandbanks feature within the SAC falls within four WFD waterbodies, therefore these are likely to be a good reflection of the overall effect of water quality on feature. The Conwy Bay and Anglesey North waterbodies overlap with the largest proportion of the sandbanks feature (38% and 30% respectively). One of the four WFD waterbodies, Conwy, overlaps with a very small proportion of the sandbanks feature (<0.5%), therefore it was not considered further in the condition assessment.

Nutrients (DIN only) and phytoplankton

The indicators for nutrients (DIN only) and phytoplankton met the targets. For the nutrients indicator (DIN only), three of the four WFD waterbodies that overlap with the sandbanks feature were classified as High status for DIN in the 2024 cycle 3 interim classification. Combined, these waterbodies overlap with 47% of the feature. One WFD waterbody, Anglesey North, was not classified for the DIN element in the 2024 cycle 3 interim classification as there were no data collected on this element over the last six years. The confidence in the pass was reduced to medium due to this unclassified waterbody.

Three of the four WFD waterbodies were classified as Good or High status for the phytoplankton element in the 2024 cycle 3 interim classification. Combined, these overlap with 47% of the feature. One of these waterbody classifications (Menai Strait) was rolled forward from the 2018 cycle 2 interim classification. The other overlapping WFD waterbody was not classified for phytoplankton. Classification of some WFD waterbodies is not suitable or possible for this element due to WFD classification methodology, or due to the nature of the waterbodies (e.g. turbidity levels). The confidence was reduced to medium due to the rolled forward classification and unclassified waterbody. In addition, the ecological relationships between phytoplankton and the sandbanks feature are not well understood.

Dissolved oxygen

The dissolved oxygen indicator met its target. The dissolved oxygen samples were taken at the water's surface. By the time oxygen depletion at the surface is recorded, oxygen throughout the water column could have been depleted for some time, especially as hypoxia or low oxygen levels, when present, typically occur in bottom water and sediments. Therefore, surface sampling of dissolved oxygen may not detect issues for more demersal features. This reduced the confidence in the pass to medium.

Contaminants

Three of the four WFD waterbodies that overlap with the sandbanks feature in the SAC have a fail for chemicals in the 2024 cycle 3 interim classification. Combined, these waterbodies overlap with 68% of the feature. This caused the contaminants indicator to fail. The failures were in the Conwy Bay (PAH), Anglesey North (mercury and PBDE) and Conwy (PBDE, mercury, PAH and cypermethrin) waterbodies. The Conwy Bay and Anglesey North waterbodies overlap with the largest proportion of the feature (38% and 30% respectively).

There has been a waterbody status change from pass to fail in the Conwy Bay waterbody between the 2021 cycle 3 classification and the 2024 cycle 3 interim classification, however the failing contaminant (PAH) was not classified in previous cycles. In the Anglesey North waterbody, mercury has failed since the 2015 cycle 2 classification. The EQS for mercury is based on the secondary poisoning protection goal (for wildlife). The PBDE failures were based on the value of the human health protection goal as it is the most stringent. This protection goal may be over precautionary as the effect of contaminants on the biota of sandbanks are not fully understood. The confidence in the fail was reduced to reflect this.

The other overlapping WFD waterbody has a pass for chemicals in the 2024 cycle 3 interim classification. However, the classifications were rolled forward from the 2018 cycle 2 interim classification as they were not classified in the 2024 cycle 3 interim classification. Overall, the confidence in the fail was medium as the human health standard has been used for PBDE, and due to the roll forward of some chemical classifications. In addition, the impact of the failing contaminants on the feature are not fully understood.

Turbidity and physicochemical properties

The turbidity indicator was assessed as unknown due to insufficient data. There were some data available from WFD Regulations sampling of suspended particulate matter. However, this is limited to only a few samples per year and therefore cannot be used to adequately assess the turbidity.

Data from NRW monitored subtidal temperature loggers from two sites within the SAC were available. However, as loggers from one of the monitoring sites had a large amount of missing data, the observed patterns in temperature are based on data from only one monitoring site which overlaps with the feature. These loggers showed an increase in temperature in more recent years. An external report (Smyth et al., 2022) also found that the annual mean sea surface temperature was gradually rising in the Menai Strait. It is not understood if the observed increases in temperature are localised to the SAC, or if they are consistent with the effects of climate change. The physicochemical indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).

Species and communities

Abundance, distribution and species composition of communities

Three of the four WFD waterbodies that overlap with the sandbanks feature were classified as Good or High status for the IQI element in the 2024 cycle 3 interim classification (Anglesey North, Menai Strait and Conwy). Combined, these waterbodies overlap with 40% of the feature. The Conwy Bay waterbody, which overlaps with 38% of the feature was classified with a Moderate status for the IQI, but with an uncertain confidence. The WFD investigation report for this waterbody (Moore and Green, in draft) concluded that the Moderate classification in the 2018 cycle 2 interim and 2021 cycle 3 classifications is a fair representation of the waterbody and thus Conwy Bay coastal waterbody is failing to meet Good Ecological Status for IQI.

Analysis of the transect monitoring data of the two monitored sandbanks for the macrobenthic infaunal communities showed variations across the sampling period (2001-2019) (NRW unpublished data). Within the Red Wharf Bay sandbank, the infaunal communities composition fluctuated with no clear reason. There were however some concerns as data showed a high number of opportunistic species found in 2001, 2010 and 2019 (NRW unpublished data). This is suggestive of disturbance but the pattern observed was inconsistent and is difficult to determine whether it is of natural or anthropogenic origin. For this reason, this did not contribute to the failure of the indicator but will be something to pay close attention in the next assessment.

Analysis of the infaunal community composition at monitoring stations within Conwy Bay indicated spatial variability in diversity indices and infaunal community structure which is likely to be linked to sediment composition across monitoring stations in Conwy Bay (Cappelli et al., in draft). There was a notable change in faunal composition and recorded sediment type at many samples from 2007 compared with later years (2010-2019), which corresponded with a shift in sediment from 2007 (sand to a more muddy sand). Many of the stations within the Conwy Bay waterbody were characterised by higher numbers of opportunistic species such as *Lagis koreni*, *Mediomastus fragilis* and *Tubificoides pseudogaster* (agg), especially in the middle eastern part of Conwy Bay. Generally, lower Shannon-Weiner diversity and Warrick statistic, and higher numbers of individuals were observed in the middle eastern part of Conwy Bay, possibly suggesting the dominance of a few taxa and indicating stressed conditions. This seems to have become worse since 2007, although long-term data analysis showed 2007 to be an exceptional year (Moore and Green, in draft). The reasons for this localised disturbance observed in a small area relative to the overall sandbanks feature are not clear, however anthropogenic rather than natural causes were considered more likely. Additional monitoring data taken in the northern part of the sandbank showed that the infaunal community composition changed across the sampling period, but the changes were considered to be within the bounds of natural variation (NRW unpublished data).

Overall, the abundance, distribution and species composition of communities indicator failed to meet the target due to the IQI failure in the Conwy Bay waterbody and the increase of opportunistic species in the middle eastern part of Conwy Bay sandbank. Confidence was reduced to medium as the increase in opportunistic species is a localised issue with unclear causes.

Species richness and diversity

Within the Red Wharf bay sandbank, species richness and diversity were found to be within the bounds of natural variation, however there were big peaks in abundance in 2001, 2010 and 2019 (NRW unpublished data). Species richness had been increasing over time for the sandbank in Conwy Bay, but there was a decline in species diversity in 2019. The most seaward station also showed an exponential increase of abundance that are unlikely to be natural. The anomalies for both monitored sandbanks were not deemed to be large enough changes to fail the indicator but did reduce confidence in the assessment to medium and will require consideration in the next assessment.

The average distinctness of the infaunal community of the two monitored sandbanks remained stable and within the expected values for most of the monitoring period, especially within recent years. A high confidence was attributed to the pass due to the availability of long term monitoring data.

Invasive non-native species

The American jack knife clam *Ensis leei* is a NNS from the USA and has been recorded in one station in 2019 for the first time at the sandbank in Conwy Bay. While it is unknown how much impact this clam will have on the condition of sandbanks, it was assessed as "minor" for impact on the feature (Tillin et al., 2020). Records of *Crepidula fornicata* were identified in 2006 however, following an eradication attempt, no records of the species were identified until recently. Within the last six years, this species has become established (i.e. since 2019) and numbers are increasing. These records are within or very close to the sandbanks feature. The arrival or reappearance of these species have resulted in a fail for the tertiary target of the NNS indicator. Confidence is high as these are new NNS recorded in the feature within the last six years.

It is not fully understood how some of these species may impact the condition of the sandbanks feature within the SAC, and effects on the species diversity and composition have not yet been observed. As there is no current impact from the INNS present the primary target of the INNS indicator passed. Confidence is low as the spread and impacts of the INNS present within the feature are not well understood and there has been no targeted survey of NNS on sandbanks.

Reasons for target failure

The assessment of the sandbanks feature in the Menai Strait and Conwy Bay SAC failed one primary target, one secondary target and one tertiary target. This resulted in the feature to be assessed as being in **unfavourable** condition. The failing indicators and reasons for failure, if known, are stated below.

Abundance, distribution and species composition of communities

This indicator has a primary weighting. The sandbanks feature is partly within Conwy Bay waterbody which has been classified with a Moderate status for the IQI element. There was an IQI failure in the Conwy Bay waterbody in the 2015 cycle 2, 2021 cycle 3 and 2024 cycle 3 interim classifications. There were also elevated numbers of small opportunistic species within the community in the eastern part of the bay, southwest of the Great Orme's Head, throughout the monitoring period, which indicates stressed environmental conditions. A significant shift in the composition of benthic species could result in various undesirable disruptions within the marine ecosystem, including impacts on food webs. From the evidence it is not clear what is causing this disturbance. The elevated number of opportunistic species such as *L. koreni*, *M. fragilis* and Oligochaeta, may be related to a localised changes in nutrients and increased deposition. Work is ongoing to determine the impact of local water discharges and other factors. Further investigation will be needed to understand the reasons for this failure and allow management measures to be implemented.

Water quality: contaminants

This indicator target has a secondary weighting. The sandbanks feature overlaps with a large proportion of two WFD waterbodies, Anglesey North and Conwy Bay, which fail for chemicals due to mercury, PBDE and PAH. Historically, the main source of PBDE is as flame retardants in a variety of materials (Viñas et al., 2022). Mercury has been used in

many industries, but today the primary sources are burning of coal and artisan mining for mercury (Larsen and Hjermann, 2022). PAHs can be produced through natural processes, but also arise from anthropogenic sources, for example during combustion of fossil fuels and organic material (Webster and Fryer, 2022).

Some of the contaminants in the water column may be derived from diffuse sources including atmospheric deposition or contaminated waterbody bed sediments. However, WFD investigations of the failures in both waterbodies are yet to be undertaken. Mercury and PBDE are being managed in the UK and it is hoped that these levels will reduce over time. There is currently no specific management in place for PAH in Wales. The PAH EQS is based on the most sensitive taxa and may not be applicable to all of the sandbanks biota. The impacts of PAH on the sandbanks feature are not fully understood.

Non-native species

This indicator failed to meet its tertiary target of no increase in the number of introduced NNS by human activities. This is due to an increase in records of NNS in the SAC, including *E. Leeis* and *C. fornicata* within the last six years. The full extent of the impact that these species, along with other NNS present within the SAC, may have on the condition of the feature is currently unknown. For this reason it did not fail the primary target of the INNS indicator. A biosecurity plan for INNS has been developed for the SAC. The objective is to manage the key pathways by which marine INNS are introduced and spread at the SAC level through the use of good biosecurity.

Threats to condition

Part of the condition assessment is to identify threats to the condition of sandbanks. A threat is defined as an activity that is currently not impacting condition but has the potential to do so over the next reporting cycle, if activity levels increase or are unmanaged. It is important to identify these threats to be able to put pre-emptive management in place to prevent declines in condition.

Activities that go through licencing and permission process whereby the impact of the activity on the feature would be assessed have not been included. The threats to the sandbanks feature condition in the Menai Strait and Conwy Bay SAC are stated below.

Invasive non-native species

INNS are not currently having an impact on the feature but high numbers in the future may have an impact on sandbanks feature.

There have been new records of *C. fornicata* on or very close to the Menai Strait sandbank (three confirmed records in 2023 and 2024). At high densities, this species could cause an impact on the feature (see further detail in Section 3.1). However, the spread and impact of this species on the feature is not fully understood.

E. leei has been found in the sandbank in Conwy Bay. Large amount of shell was recently found in Red Wharf Bay and Benllech beach, potentially indicating a high population level. Dense populations of *E. leei* could lead to change of sediment composition with an increase of finer sediment (Rees, 2020).

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. This SAC could be at risk since there are a number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Water quality: contaminants

There is the potential for unregulated contaminants (such as PFAS) to increase. This could affect some of the biota of the sandbanks feature as PFAS has been shown to bioaccumulate in marine species, increasing up the trophic levels (Khan et al., 2023). However, the biological impact of PFAS on marine species is not well understood.

Some persistent chemicals are not measured in every WFD waterbody, and some of the relevant WFD waterbodies have not been classified for any chemicals.

Climate change

It is not yet clear what pressures we will see from climate change at the site level or how different pressures will counter act each other. However, threats from climate change may include (Gihwala et al., 2024):

- Changes in sea temperature and salinity.
- Ocean acidification.
- Changes in species distribution.

Evidence gaps

There are gaps in the current evidence that NRW feel are needed to be filled to fully understand condition in this feature.

Listed below (Table 12) are current indicators that were either assessed as unknown, not assessed, or assessed with a lower confidence. This was due to either limited data availability, outdated data, or a lack of information. Some indicators are not currently monitored but should be ideally considered in future condition assessments.

Table 12. Evidence gaps for the sandbanks feature in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see Section 1.1).

Indicator	Assessed status	Comments
Distribution and extent of habitats and communities (P)	Not assessed	• Biotopes are not well established for sandbanks. There is a lack of any recent information on biotopes classification for sandbanks therefore this indicator was not assessed in any of the SACs.

Indicator	Assessed status	Comments
Topography of the feature (P)	Medium confidence (proxy data used)	• The topography of sandbanks is not well monitored in all SACs. More bathymetry surveys for all sandbanks are required in future.
Hydrodynamic and sediment transport processes (P)	Medium confidence (proxy data used)	• The hydrodynamic regime of sandbanks is not currently monitored in all SACs.
Invasive non-native species (P)	Low confidence (limited data)	• The spread and impact of NNS currently present within the SAC on the sandbanks feature is not fully understood. More targeted surveys and investigation on the impact of NNS on sandbanks are needed.
Sediment quality: oxidation-reduction profile (S); volume (S); organic carbon content (S); contaminants (S)	Not assessed	• These aspects are not currently monitored in sandbank sediment particle size analysis (PSA), but could be incorporated into analysis in future.
Water quality: turbidity (S)	Unknown	• Turbidity is measured in WFD sampling. As this is limited to only a few samples per year it cannot be used to adequately assess the turbidity. • Investigation of the use of remote sensing data to assess turbidity could be carried out in the future. External data from other organisations could also be used.
Water quality: physicochemical properties (S)	Unknown	• Further evidence on temperature change is required to adequately assess this indicator. Some physicochemical parameters such as salinity and pH have not been assessed. These could be considered in future as some monitoring data are available. • Remote sensing data on temperature, salinity and pH could be used in future.

3.4. Large shallow inlets and bays condition assessment

The large shallow inlets and bays (LSIB) feature in Menai Strait and Conwy Bay SAC is Conwy Bay and this also includes other smaller bays for example Red Wharf Bay (Figure 10). The condition assessment was completed using information specific to the LSIB in combination with any available data on the nested designated features contained within the LSIB.

Figure 10. Map of the LSIB feature in Menai Strait and Conwy Bay SAC.
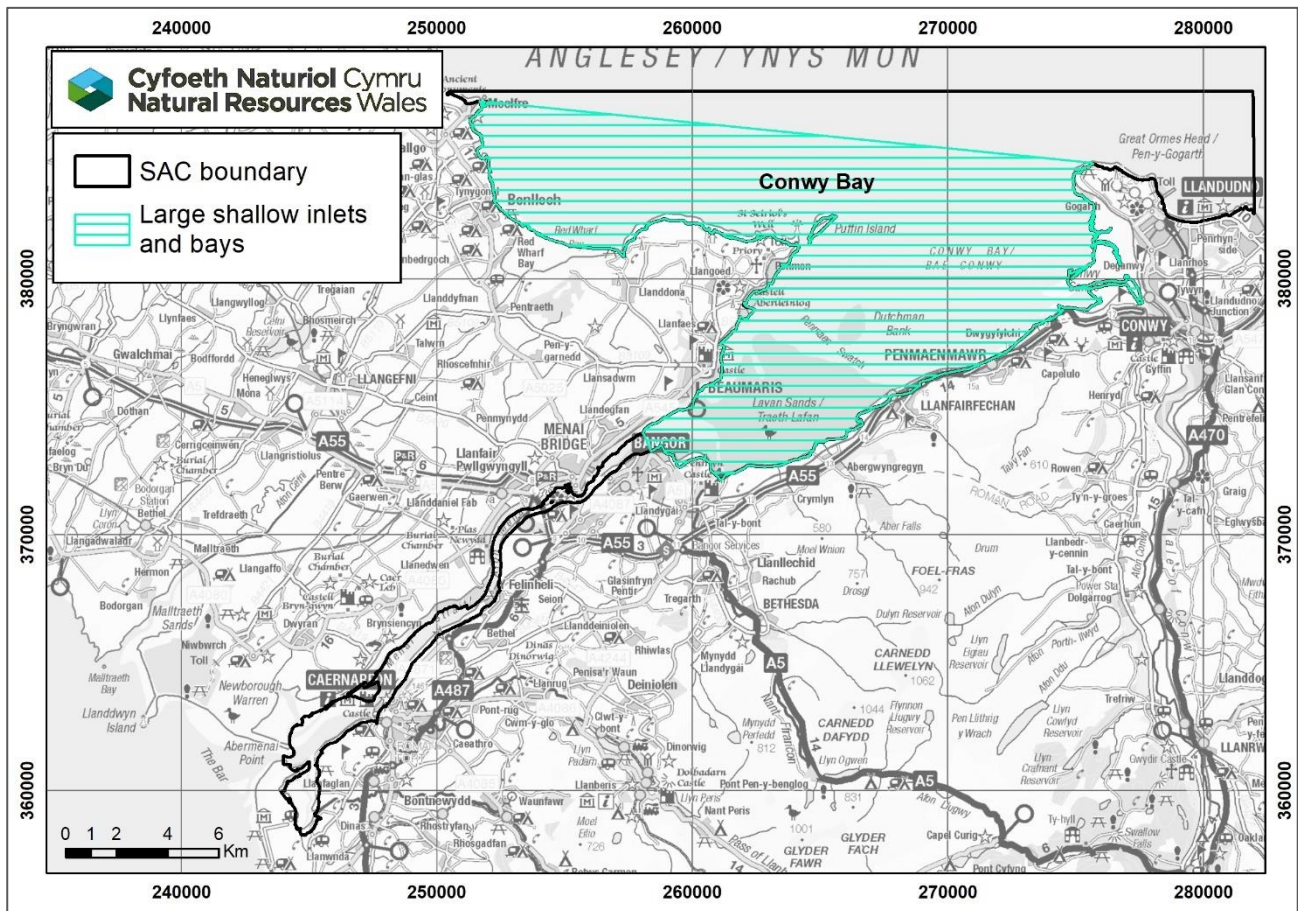
The LSIB includes some nested features: sandbanks, mudflats and sandflats and reefs. Fish communities were only broadly considered due to resource limitations but there is some information included in the detailed assessment section. Table 13 has a summary of the assessment outcome. This outcome and reasons of failure are discussed in more detail in the sections below.

Table 13. Condition assessment of LSIB in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see Section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Feature Extent	No significant decrease in extent of LSIB within the SAC, allowing for natural change. (P)	• LSIB are a physiographic feature and the extent of the LSIB feature would be unlikely to change. • There are currently no anthropogenic impacts known to be significantly affecting the extent of LSIB in the SAC. • Confidence is medium as the assessment has not been based on comparison mapping of the feature and expert judgment was used.	**Pass**	Medium
Distribution and extent of habitats and communities	Maintain the distribution and extent of LSIB habitats and communities, allowing for natural change and variation. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the distribution and extent of habitats and communities of LSIB and its nested features in the Menai Strait and Conwy Bay SAC. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Sediment composition and distribution	Maintain composition and distribution of sediment granulometry across the LSIB, allowing for natural change and variation. (P)	• No issues were identified for the overlapping nested features: sandbanks, and mudflats and sandflats. • The NRW monitoring of the sublittoral soft sediment in Red Wharf Bay from 2007 to 2022 indicated no concerns. • The monitoring analysis of the sublittoral soft sediment in Conwy Bay from 2007 to 2019 indicated that sediment composition was relatively stable across the monitoring period. o However, analysis showed evidence of silt increase in one of the surveillance sites and in the eastern part of Conwy Bay. This resulted in a medium confidence pass for this target.	**Pass**	Medium
Sediment quality: oxidation-reduction profile (redox layer)	No decrease in the depth of the redox layer from the surface that is considered detrimental to LSIB infaunal communities, allowing for natural change and variation. (S)	• This assessment uses the results of the condition assessment from the mudflats and sandflats feature as a proxy as there were no other data available. The redox layer profile of the monitored mudflats and sandflats indicated no clear trend over the years. • Confidence is low due to the use of proxy data and as a large proportion of the mudflats and sandflats is not within the LSIB. Additional sampling is needed to improve temporal resolution and data continuity, which are required to understand ongoing processes and confirm overall trends.	**Pass**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of the LSIB. (S)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of the feature. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity, allowing for natural variation and change. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the hydrodynamic and sediment transport processes of the feature. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Water quality: nutrients (DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (P)	• One of the five WFD waterbodies that overlap with the feature was not classified for DIN in the 2024 cycle 3 interim classification (Anglesey North). It overlaps with 32% of the feature. • The other four WFD waterbodies were classified as Good or High status for DIN (Conwy Bay, Menai Strait, North Wales and Conwy). Combined, these overlap with 55% of the feature. • Confidence is medium due to the one unclassified waterbody.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: phytoplankton	The WFD classification achieved for phytoplankton should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• One of the five WFD waterbodies was classified with a Moderate status for phytoplankton in the 2024 cycle 3 interim classification (North Wales). However, it overlaps with <1% of the feature. • One WFD waterbody was not classified for this WFD element (Anglesey North). It overlaps with 32% of the feature. • The other three WFD waterbodies were classified with Good or High status for phytoplankton (Conwy Bay, Menai Strait and Conwy). Combined, these overlap with 55% of the feature. o The Menai Strait waterbody classification was rolled forward from the 2018 cycle 2 interim classification. • Confidence is medium due to one unclassified waterbody, and rolled forward classification.	**Pass**	Medium
Water quality: opportunistic macroalgae	The WFD classification achieved for opportunistic macroalgae should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• One of the five WFD waterbodies was classified with a High status for opportunistic macroalgae in the 2024 cycle 3 interim classification (Conwy). It overlaps with 2% of the feature. • The other four WFD waterbodies have not been classified for opportunistic macroalgae in any cycles. Combined, these overlap with 85% of the feature. • This indicator was assessed as unknown as a large proportion of the feature overlap with waterbodies that have not been classified for this WFD element.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: dissolved oxygen	The WFD classification achieved for dissolved oxygen should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (P)	• All five WFD waterbodies that overlap with the feature were classified with a High status for dissolved oxygen in the 2024 cycle 3 interim classification. • Confidence is medium due to samples being taken from the surface of the waterbody which may not detect issues for more demersal habitats within the LSIB feature.	**Pass**	Medium
Water quality: contaminants	Water column contaminants not to exceed the EQS. (S)	• Two of the five WFD waterbodies have a pass for chemicals in the 2024 cycle 3 interim classification (Menai Strait and North Wales). In both of these waterbodies the classifications were rolled forward from previous cycles as they were not classified in the 2024 cycle 3 interim classification. • The other three WFD waterbodies have a fail for chemicals (Anglesey North, Conwy Bay and Conwy). Combined, these overlap with 60% of the feature. Chemicals that failed were mercury, PBDE, PAH and cypermethrin. • Confidence is medium as the human health standard has been used for PBDE, and due to the roll forwards in some chemical classifications.	**Fail**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: turbidity	Maintain expected levels of turbidity, allowing for natural change and variation. (S)	• There are limited data on turbidity for the LSIB feature in the Menai Strait and Conwy Bay SAC, therefore this target was assessed as unknown.	**Unknown**	N/A
Water quality: physicochemical properties of the water column	Maintain expected physicochemical properties of the water, allowing for natural change and variation. (S)	• Data from subtidal temperature loggers from within the SAC were available. Loggers at one monitoring site indicated a potential increase in temperature in recent years. It is not clear if this is a localised change or in line with global trends. Loggers at the other monitoring site were missing a large amount of data between 2016 and 2021. • An external report from Bangor University indicates that annual mean sea surface temperature is gradually rising in their Menai Strait temperature logger. • It is not understood if the observed increases in temperature are localised to the SAC, or if they are consistent with the effects of climate change. • This indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Abundance, distribution and species composition of communities	Maintain the abundance, distribution, and diversity of species within communities and component habitats, allowing for natural change and variation. (P)	• No issues were identified for the overlapping nested mudflats and sandflats feature. • The indicator failed for the sandbanks. This nested feature overlaps with 49% of the LSIB feature. • Spatial variability in infaunal community composition across monitoring stations in Red Wharf Bay was considered within the limits of natural variation. • Analysis of monitoring data in Conwy Bay indicated some disturbance from opportunistic species especially in the eastern part of the bay, southwest of the Great Orme's Head. Opportunistic species included the polychaetes *Lagis koreni, Mediomastus fragilis* and the oligochaete *Tubificoides pseudogaster,* which were dominant over the monitoring period, possibly indicating stressed environmental conditions. • Three of the five WFD waterbodies were classified as Good or High status for the IQI WFD element in the 2024 cycle 3 interim classification (Anglesey North, Menai Strait and Conwy). Combined, these overlap with 61% of the feature. However, the Conwy Bay waterbody, which overlaps with 26% of the feature was classified with a Moderate status. • The confidence has been set as medium due to the localised failure and the lack of understanding around the impact that failure may have on LSIB.	**Fail**	Medium

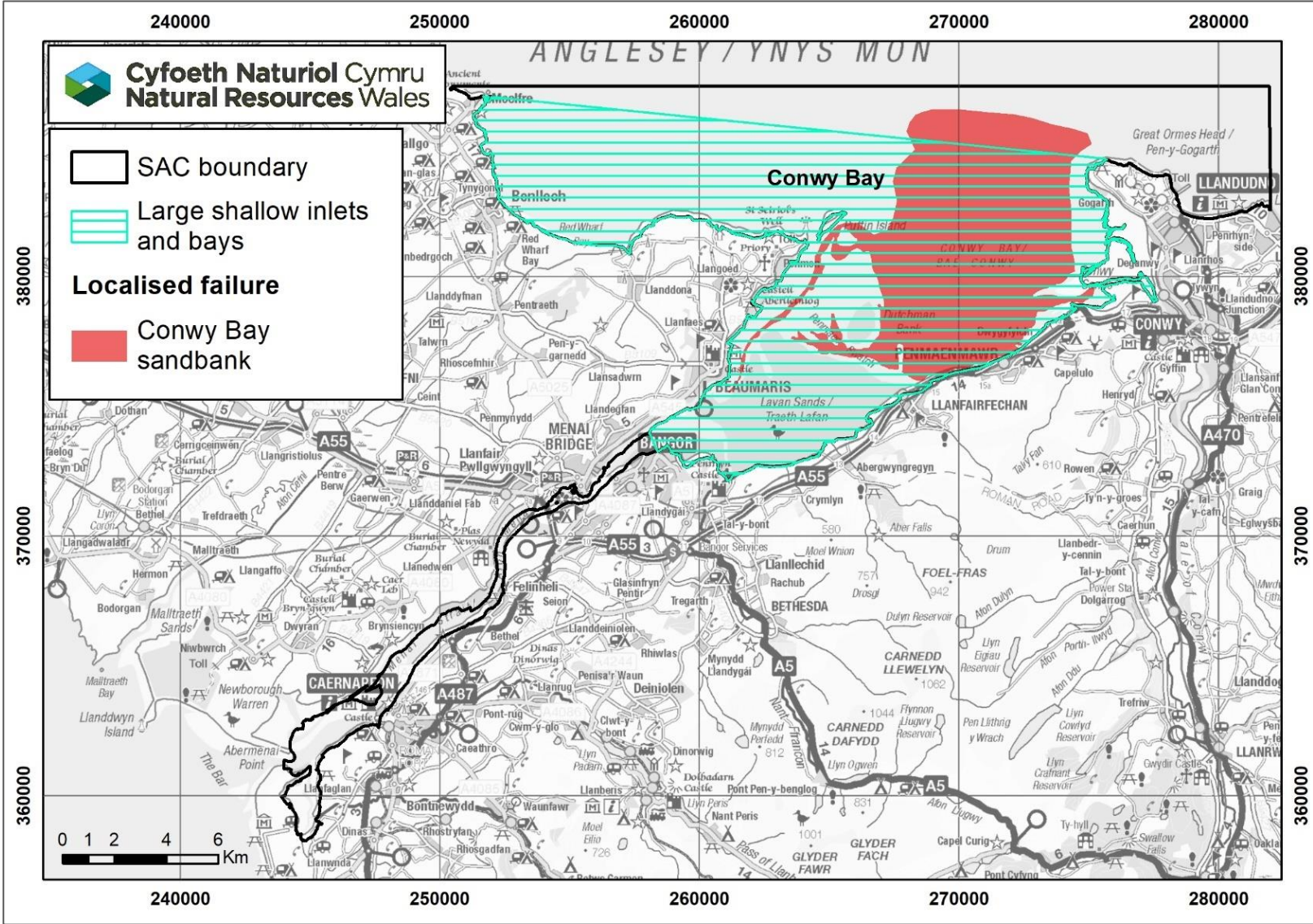| Indicator	Target	Assessment rationale	Target assessment	Target confidence
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities should not adversely affect the condition of the feature. (P)	• There is limited evidence to suggest that INNS (e.g. *Gracilaria vermiculophylla*) are currently impacting the condition of LSIB in the SAC. • Confidence is low as the spread and impacts of the INNS present within the feature are not understood.	**Pass**	Low
Non-native Species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• *G. vermiculophylla* has been recorded within the last six years in the Traeth Lafan sandflats in the Menai Strait, which is within the LSIB feature. • Other NNS have been recorded previously including *Magallana gigas* and *Sargassum muticum* within the LSIB feature. • Confidence is high due to the arrival of NNS within the last six years, and good availability of records.	**Fail**	High

Assessment conclusions

The large shallow inlets and bays (LSIB) feature in Menai Strait and Conwy Bay SAC has been assessed as being in **unfavourable** condition (medium confidence). There were a number of indicators with failing targets (Table 14). Further investigation is needed to better understand all of the failures to be able to identify management options that can bring the feature back into favourable condition. As the primary failure was localised, it has been mapped to help focus management effort (Figure 11).

A summary of the assessment can be seen in Table 14 with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 14. Summary of the condition assessment for LSIB in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

Feature	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Large shallow inlets and bays	**Unfavourable (medium confidence)**	Abundance, distribution and species composition of communities (P) Water quality: contaminants (S) Non-native species (T)	• There is an IQI failure for the Conwy Bay waterbody, and localised elevated numbers of opportunistic species, indicating stressed environmental conditions. • Levels of mercury, PBDE, PAH and cypermethrin in the Anglesey North, Conwy Bay and Conwy waterbodies are failing to meet their relevant EQS. • There are recent records of *G. vermiculophylla* within the LSIB feature.	• Unconsented infrastructure • INNS • Water quality: contaminants • Management of coastal defences • Climate change • Recreational access and collection

Figure 11. Map of the localised failure in the LSIB feature in Menai Strait and Conwy Bay SAC.

Detailed assessment information

Extent and distribution

The feature extent indicator in the Menai Strait and Conwy Bay SAC passed its target as there are currently no known anthropogenic impacts that would significantly affect the extent of the LSIB feature. LSIB are a physiographic feature and the extent of the LSIB feature would be unlikely to change. The distribution and extent of habitats and communities indicator also met its target for this reason, and because there are no known impacts to the distribution and extent of the nested features. Comparison mapping has not been used to assess the extent and only expert judgment was used to assess communities distribution in the absence of recent data. This has reduced the confidence to medium.

Sediments

Composition and distribution

In the condition assessments of the sandbanks feature and mudflats and sandflats features, the sediment composition and distribution indicators passed their targets. These features overlap with approximately 49% and 17% of the LSIB feature, respectively.

The NRW monitoring analysis of the sublittoral soft sediment in Red Wharf Bay from 2007 to 2016 showed small changes in sediment composition that were within the bounds of natural variation (Clark et al., in draft). Additional data up to 2022 further supports this with no concerning changes in sediment composition (NRW unpublished data).

The NRW monitoring analysis of the sublittoral soft sediment in Conwy Bay from 2007 to 2019 indicated that sediment composition was relatively stable across the monitoring period (Cappelli et al., in draft). There were some concerns, however, with the increase of silt in the eastern part of Conwy Bay (also observed in one of the surveillance sites), which may be related to the changes in infaunal community composition observed. However, this is yet to be confirmed.

Overall, the sediment composition and distribution indicator met its target as there have been no concerning changes in sediments over the monitoring periods. Confidence was reduced to medium to account for the concerns over the increase in silt in a localised part of Conwy Bay.

Oxidation-reduction profile (redox layer)

The redox layer of intertidal sediments has been monitored within the mudflats and sandflats habitat. This habitat feature in the SAC overlaps with approximately 17% of the LSIB feature. It was therefore deemed acceptable to use the mudflats and sandflats condition assessment as a proxy for the sediment redox layer indicator. The indicator met its target as the redox layer profile from the mudflats and sandflats data indicated no clear trend over the surveyed years (Section 3.1). The confidence was reduced to low because the assessment uses the mudflats and sandflats condition assessment as a proxy and a large proportion of the mudflats and sandflats feature is outside the LSIB feature. Further

sampling is also required to enhance the robustness and completeness of the dataset, especially important for assessing the redox layer.

Organic carbon content and contaminants

There is no monitoring of sediment contaminants or organic carbon content within the SAC. These indicators were therefore not assessed.

Topography and hydrodynamics

The topography and hydrodynamic and sediment transport processes are not well researched for LSIBs. These targets passed with medium confidence based on the knowledge that there are currently no anthropogenic activities that are known to have a significant impact on the feature within the SAC.

Water quality

It has been estimated that approximately 87% of the LSIB feature within the SAC falls within five WFD waterbodies (Figure 12), therefore these are likely to be a good reflection of the overall effect of water quality on the feature. The Anglesey North, Menai Strait and Conwy Bay waterbodies overlap with the largest proportion of the feature (32%, 27% and 26% respectively). The other two WFD waterbodies overlap with a very small proportion of the feature.

Figure 12. Map of the WFD waterbodies that overlap with the LSIB feature within Menai Strait and Conwy Bay SAC.
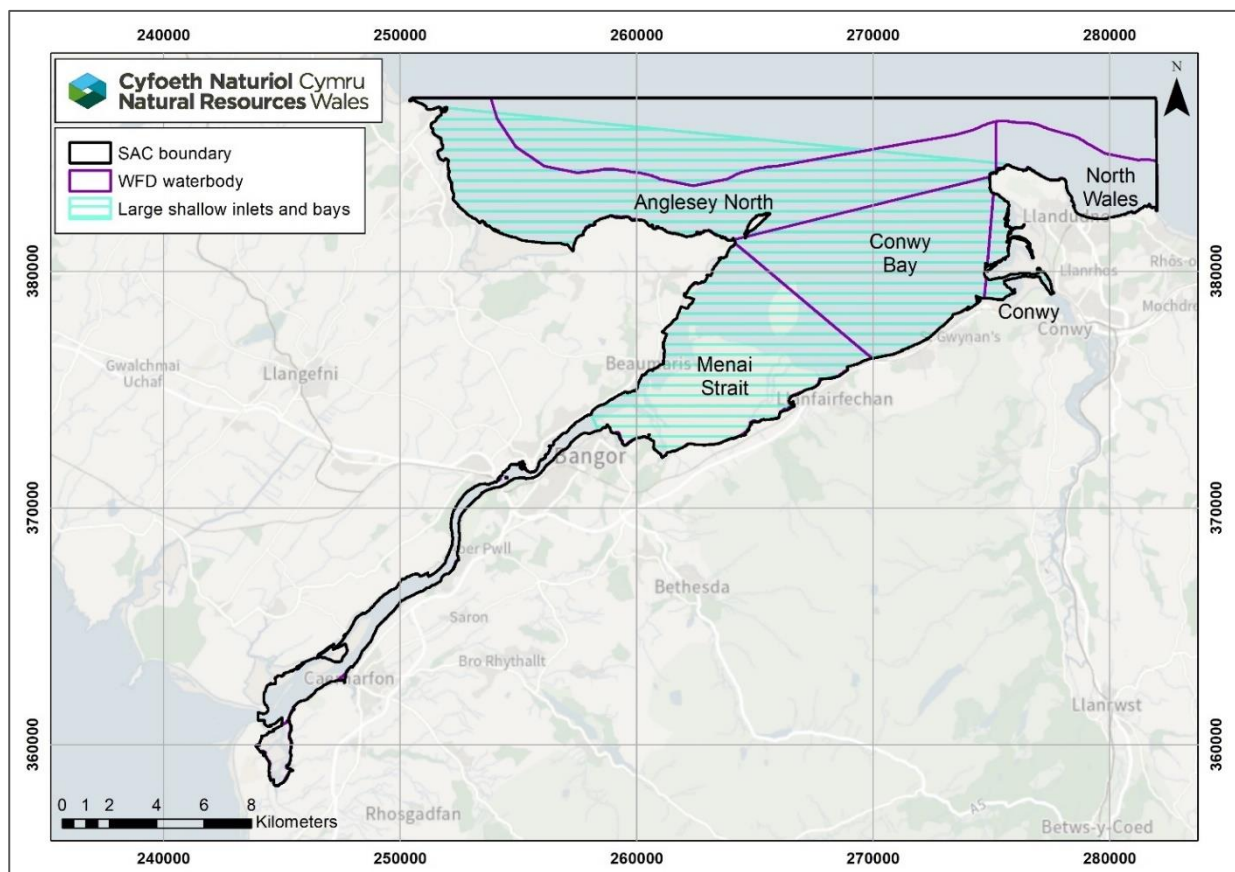
Nutrients (DIN only)

The nutrients (DIN only) indicator met its target as a large proportion of the feature (55%) overlaps with WFD waterbodies that were classified as Good or High status for DIN in the 2024 cycle 3 interim classification. The other WFD waterbody, Anglesey North, which overlaps with 32% of the feature, was not classified for the DIN element in the 2024 cycle 3 interim classification as there were no data collected on this element over the last six years. This waterbody overlaps with the largest proportion of the feature, therefore the confidence in the assessment was reduced to medium.

Phytoplankton

The phytoplankton indicator met its target as a large proportion of the feature (55%) overlaps with WFD waterbodies that were classified as Good or High status for the phytoplankton element in the 2024 cycle 3 interim classification. The other WFD waterbody (Anglesey North) was not classified for the element in any WFD cycles. Classification of some of these waterbodies may not be suitable or possible for this element due to WFD classification methodology, or due to the nature of the waterbodies (e.g. turbidity levels). The North Wales waterbody which overlaps with the smallest proportion (0.04%) of the feature was classified with a Moderate status for phytoplankton, but this was not considered in the condition assessment. The confidence in the pass was reduced to medium due to the unclassified waterbody and as one waterbody with a High status classification was rolled forward from a previous cycle.

Opportunistic macroalgae

The opportunistic macroalgae indicator was assessed as unknown as a large proportion of the feature (85%) is within WFD waterbodies that have not been classified for the opportunistic macroalgae element in the 2024 cycle 3 interim classification. It should be noted that some WFD waterbodies are not assessed for opportunistic macroalgae as they do not have suitable substratum (i.e. areas of intertidal habitat for opportunistic macroalgal growth). The one WFD waterbody that was classified as High status was the Conwy waterbody, which overlaps with only 2% of the feature.

Dissolved oxygen

The dissolved oxygen indicator met its target. The dissolved oxygen samples are taken at the water's surface. By the time oxygen depletion at the surface is recorded, oxygen throughout the water column could have been depleted for some time, especially as hypoxia or low oxygen levels, when present, typically occur in bottom water and sediments. Therefore, surface sampling of dissolved oxygen may not detect issues for more demersal habitats within the LSIB feature. This reduced the confidence in the pass to medium.

Contaminants

Three of the five WFD waterbodies that overlap with the LSIB feature in the SAC have a fail for chemicals in the 2024 cycle 3 interim classification. Combined, these waterbodies overlap with approximately 60% of the feature. This caused the contaminants indicator to fail. The failures were for the Anglesey North (mercury and PBDE), Conwy Bay (PAH), and Conwy (PBDE, mercury, PAH and cypermethrin) waterbodies.

There has been a waterbody status change from pass to fail in the Conwy Bay waterbody between the 2021 cycle 3 classification and the 2024 cycle 3 interim classification, however the failing contaminant (PAH) was not assessed in previous cycles. Similarly, in the Conwy waterbody, two of the failing contaminants (PAH and cypermethrin) were not previously classified. With the exception of the 2021 cycle 3 classification, mercury has failed in this waterbody in all classifications since the 2015 cycle 2 classification. The waterbody status changes for mercury between cycles are likely due to changes in WFD classification methodology. Cypermethrin is a synthetic pyrethroid insecticide and is highly toxic to some aquatic species (EA, 2019), but now has a restricted use in Wales. The EQS for cypermethrin is very low, and in the previous laboratory methodology, it was not possible to detect concentrations below the EQS. There was an additional failure for zinc in the 2021 cycle 3 classification the Conwy waterbody, but this no longer fails in the 2024 cycle 3 interim classification. In the Anglesey North waterbody, mercury has failed since the 2015 cycle 2 classification. The EQS for mercury is based on the secondary poisoning protection goal (for wildlife). The PBDE failures were based on the value of the human health protection goal as it is the most stringent. This protection goal may be over precautionary as the effect of contaminants on the biota of LSIB are not fully understood. The confidence in the fail was reduced to reflect this.

The other two overlapping WFD waterbodies have a pass for chemicals in the 2024 cycle 3 interim classification. However, in both waterbodies the classifications were rolled forward from previous cycles as they were not classified in the 2024 cycle 3 interim classification. This also contributed to the reduced confidence. In addition, the impact of the failing contaminants on the feature are not fully understood.

Turbidity and physicochemical properties

The turbidity indicator was assessed as unknown due to insufficient data. There were some data available from WFD Regulations sampling of suspended particulate matter. However, this is limited to only a few samples per year and therefore cannot be used to adequately assess the turbidity.

Data from NRW monitored subtidal temperature loggers from two monitoring sites within the SAC were available. However, as loggers from one of the sites had a large amount of missing data, the observed patterns in temperature are based on data from only one site which overlaps with the feature. These loggers showed an increase in temperature in more recent years. An external report (Smyth et al., 2022) also found that the annual mean sea surface temperature was gradually rising in the Menai Strait. It is not understood if the observed increases in temperature are localised to the SAC, or if they are consistent with the effects of climate change. The physicochemical indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).

Species and communities

WFD classifications

Three of the five WFD waterbodies that overlap with the LSIB feature were classified as Good or High status for the IQI element in the 2024 cycle 3 interim classification (Anglesey North, Menai Strait and Conwy). Combined, these waterbodies overlap with 61% of the

feature. One of these waterbodies, Conwy, has deteriorated from High status in the 2021 cycle 3 classification to Good status in the 2024 cycle 3 interim classification. However, this waterbody overlaps with a small proportion of the feature (2%). The Conwy Bay waterbody, which overlaps with 26% of the feature was classified with a Moderate status for the IQI element, but with an uncertain confidence. The WFD investigation report for this waterbody (Moore and Green, in draft) concluded that the Moderate classification in the 2018 cycle 2 interim and 2021 cycle 3 classifications are a fair representation of the waterbody and thus Conwy Bay coastal waterbody is failing to meet Good Ecological Status for IQI. The final overlapping WFD waterbody has a very small overlap with the feature (0.04%) and has not been classified for the IQI element.

Species and communities in nested features

The mudflats and sandflats feature overlaps with approximately 17% of the LSIB feature. The condition assessment of the mudflats and sandflats feature concluded that the abundance, distribution and species composition of communities indicator met the criteria for a pass (Section 3.1).

The reefs feature overlaps with approximately 4% of the LSIB feature. The abundance, distribution and species composition of communities indicator met its target for the intertidal reefs part of the condition assessment of the reefs feature. The indicator failed for subtidal reefs due the decline in sponge communities. The failure, however, is localised to Coleg Normal monitoring site in the Menai Strait, which is outside of the LSIB feature and therefore was not relevant to the LSIB feature (Section 3.2).

The sandbanks feature overlaps with approximately 49% of the LSIB feature. The abundance, distribution and species composition of communities indicator failed to meet its target in the condition assessment of the sandbanks feature (Section 3.3). The information for the infaunal community composition for both sandbanks and LSIB feature were based on the monitoring of soft sediment within Conwy Bay (Cappelli et al., in draft).

Species and communities in LSIB feature

Analysis of the infaunal community composition at monitoring stations within Conwy Bay indicated spatial variability in diversity, quality indices and infaunal community structure which is likely to be linked to sediment composition across monitoring stations in Conwy Bay (Cappelli et al., in draft). There was a notable change in faunal composition and recorded sediment type at many samples from 2007 compared with later years (2010-2019), which corresponded with a shift in sediment from 2007 (sand to a more muddy sand). Many of the stations within the Conwy Bay waterbody were characterised by higher numbers of opportunistic species such as *Lagis koreni*, *Mediomastus fragilis* and *Tubificoides pseudogaster* (agg), especially in the middle eastern part of Conwy bay. Generally lower Shannon-Weiner diversity, lower Warrick statistic and higher numbers of individuals were observed in the middle eastern part of Conwy Bay, possibly suggesting the dominance of a few taxa and perhaps stressed conditions. This seems to have got worse since 2007, although long-term data analysis showed 2007 to be an exceptional year (Moore and Green, in draft).

While there has been spatial variability in diversity and quality indices, and infaunal community composition across monitoring stations in Red Wharf Bay, these were considered to be within the limits of natural variation (Clarke et al., in draft; M. Green

(NRW), pers. comm.). One monitoring site (station 11) had an elevated number of opportunistic species which could be caused by a nearby sewage discharge (Clarke et al., in draft; M. Green (NRW), pers. comm.), and will be something to pay close attention to in the next assessment. The abundance of the polychaete *Leitoscoloplos mammosus* has increased unexpectedly in recent years in most of the inshore stations and it would be interesting to see if this trend continues in the future (M. Green (NRW), pers. comm.). This species is listed as a second-order opportunistic species present in slight to pronounced unbalanced conditions in response to stress (ICES, 2004).

Although fish within the LSIB are an important part of the community, there are limited data and resources to conduct analysis on fish communities for the LSIB feature. Data from wider Irish sea level studies such as International Council for the Exploration of the Sea (ICES) are difficult to relate to the assessment of condition at the SAC and feature level and some species that have been assessed by ICES may not even occur at the individual SAC level. However, populations of various larger-bodied bony fish species in the Irish Sea, such as bass, cod, herring, whiting, plaice and pollack, have declined in recent years (ICES, 2024a, 2024b, 2024c, 2024d, 2024e, 2024f). While there are limited data on the status of other species, the depletion of a number of larger, higher trophic level predatory species in the Irish Sea may have shifted the structure of the wider fish community to an overall lower trophic level with fewer larger predatory fish species.

Overall, the IQI failure in Conwy Bay waterbody and the elevated opportunistic species in the eastern part of Conwy Bay resulted in the failure of the abundance, distribution and species composition of communities indicator. The confidence has been set as medium due to the localised failure and the lack of understanding around the impacts that failure may have on LSIB.

Invasive non-native species

Gracilaria vermiculophylla was recorded within the last six years in the sandflats at Traeth Lafan (Mercer and Brazier, 2023), within the LSIB feature (Conwy Bay). Therefore, the tertiary target of the NNS indicator failed with high confidence due to the new NNS recorded in the LSIB feature within the last reporting cycle.

Other NNS are known to be present in the Conwy Bay including *Magallana gigas* and *Sargassum muticum*. The cover of *S. muticum* is thought to be extensive in the SAC, however this species is not consistently recorded. In addition there are records of other NNS at the boundary of the LSIB feature, including *Ensis leei* and *Ostrea chilensis*. Limited records have been produced for *O. chilensis,* but it has been known to be present in the Menai Strait for about 30 years. The American slipper limpet *Crepidula fornicata* has become established since 2019 in the Menai Strait following a presumed successful eradication in 2006. Although this species has not currently been recorded within the LSIB feature, there is a risk of the species becoming established in other parts of the SAC.

It is not fully understood how some of these species may spread and impact the condition of LSIB and the nested habitat features within the feature, and effects on the species diversity and composition have not yet been observed. As there is no current impact from the INNS present the primary target of the INNS indicator passed. Confidence is low as the impacts of the INNS present within the feature are not well understood.

Reasons for target failure

The assessment of the LSIB feature in the Menai Strait and Conwy Bay SAC failed one primary target, one secondary target and one tertiary target. This resulted in the feature to be assessed as being in **unfavourable** condition. The failing indicators and reasons for failure, if known, are stated below.

Abundance, distribution and species composition of communities

This indicator has a primary weighting. The LSIB feature is partly within Conwy Bay waterbody which has been classified with a Moderate status for the IQI element. There was an IQI failure in the Conwy Bay waterbody in the 2015 cycle 2, 2021 cycle 3 and 2024 cycle 3 interim classifications. There were also elevated numbers of small opportunistic species within the community in the eastern part of the bay, southwest of the Great Orme's Head, through the monitoring period, which indicates stressed environmental conditions. A significant shift in the composition of benthic species could result in various undesirable disruptions within the marine ecosystem, including impacts on food webs. It is not fully understood how some of these opportunistic species may impact the LSIB biota and the nested habitat features within the feature. From the evidence it is not clear what is causing this disturbance. The elevated number of opportunistic species such as *L. koreni*, *M. fragilis* and oligochaetes, may be related to localised changes in nutrients and increased deposition. Work is ongoing to determine the impact of local water discharges and other factors. Further investigation will be needed to understand the reasons for this failure and allow management measures to be implemented.

Water quality: contaminants

This indicator target has a secondary weighting. The LSIB feature is partly within three WFD waterbodies (Anglesey North, Conwy Bay and Conwy) which have been classified with a fail for chemicals due to mercury, PBDE, PAH and cypermethrin. Historically, the main source of PBDE is as flame retardants in a variety of materials (Viñas et al., 2022). Mercury has been used in many industries, but today the primary sources are burning of coal and artisan mining for mercury (Larsen and Hjermann, 2022). PAHs can be produced through natural processes, but also arise from anthropogenic sources, for example during combustion of fossil fuels and organic material (Webster and Fryer, 2022). Cypermethrin is an insecticide used for plant protection in crops, in forestry, gardens, homes and businesses. It is also used in veterinary medicine to control pests in livestock and pets (EA, 2019). The application of cypermethrin has been restricted for some uses (sheep dipping and in forestry against the pine weevil).

Some of the contaminants in the water column may be derived from diffuse sources including atmospheric deposition or contaminated waterbody bed sediments. However, WFD investigations of the failures in all three waterbodies are yet to be undertaken. Mercury and PBDE are being managed in the UK and it is hoped that these levels will reduce over time. There is currently no specific management in place for PAH in Wales. The PAH EQS is based on the most sensitive taxa and may not be applicable to all of the LSIB biota. The impacts of PAH on the LSIB feature are not fully understood.

Non-native species

This indicator failed to meet its tertiary target of no increase in the number of introduced NNS by human activities. *G. vermiculophylla* has been recorded within the last six years in the Traeth Lafan sandflats which is within the LSIB feature. Investigation into the management of spread of this species has not been done widely (Maggs and Magill, 2014). Targeted surveys of the species and investigation into its impact are required. There have also been some records of *C. fornicata* within the Menai strait and Conwy Bay SAC but outside the LSIB feature with establishment of the species in the southwestern end of the Menai Strait within the last reporting cycle. There is a risk that the species will become established in other areas including within Conwy Bay.

The spread and full extent of the impact that these species, along with other NNS present within the SAC, may have on the condition of the feature is currently unknown. For this reason it did not fail the primary target of the INNS indicator. A biosecurity plan for INNS has been developed for the SAC. The objective is to manage the key pathways by which marine INNS are introduced and spread at the SAC level through the use of good biosecurity.

Threats to condition

Part of the condition assessment is to identify threats to the condition of the LSIB. A threat is defined as an activity that is currently not impacting condition but has the potential to do so over the next reporting cycle, if activity levels increase or are unmanaged. It is important to identify these threats to be able to put pre-emptive management in place to prevent declines in condition.

Activities that go through licencing and permission processes whereby the impact of the activity on the feature would be assessed have not been included. The threats to the LSIB feature condition in the Menai Strait and Conwy Bay SAC are stated below.

Unconsented infrastructure

New unconsented infrastructures such as private slipways and coastal defences, modify the coastal environment through changes to micro-topography and hydrodynamics and can lead to loss of the feature extent, and impact to the flora and fauna associated with it.

Invasive non-native species

G. vermiculophylla has been found at Traeth Lafan sandflats within the SAC. This species has the potential to establish quickly in shallow soft-bottomed bays and estuaries, and can have detrimental impact on the feature (see further detail in Section 3.1).

There have been recent records of *C. fornicata* in the SAC. This species is commonly found in areas of muddy habitat. At high densities, this species could cause an impact on the feature (see further detail in Section 3.1). However, the spread and impact of this species on the feature is not fully understood.

Future increases in air and water temperatures that are expected with climate change may result in increased occurrence of conditions suitable for spawning and settlement of *M. gigas*. Northward recruitment may be expected (Smyth et al., 2022).

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. This SAC could be at risk since there are a number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Water quality: contaminants

There is the potential for unregulated contaminants (such as PFAS) to increase. This could affect some of the biota of the LSIB feature, as PFAS has been shown to bioaccumulate in marine species, increasing up the trophic levels (Khan et al., 2023). However, the biological impact of PFAS on marine species is not well understood.

Some persistent chemicals are not measured in every WFD waterbody, and some of the relevant WFD waterbodies have not been classified for any chemicals.

Management of coastal defences

The State of the UK Climate 2023 Report highlights an observed acceleration in rates of climate induced sea-level rise which, along with storm surges can cause coastal erosion and flooding (Kendon et al, 2024). Shoreline Management Plans identify the preferred approach to coastal management in light of climate change, which includes maintaining or upgrading defences in some areas and adapting the approach to management in others. Where defences continue to be maintained, there are potential impacts on coastal processes and associated habitats and species. Intertidal habitats may also be lost as a result of coastal squeeze (Oaten et al., 2024).

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counter act each other. However, threats from climate change may include (Gihwala et al., 2024, Oaten et al., 2024):

- Sea level rise.
- Changes to wave climate, especially storm frequency and intensity, which may change the topography.
- Changes in air and sea temperature.
- Changes in ocean acidification.
- Changes in species distribution.

Further threats are associated with the nested features and can be found in the relevant sections of the report.

Evidence gaps

There are gaps in the current evidence that NRW feel are needed to be filled to fully understand condition in this feature.

Listed below (Table 15) are current indicators that were either assessed as unknown, not assessed, or assessed with a lower confidence. This was due to either limited data

availability, outdated data, or a lack of information. Some indicators are not currently monitored but should be ideally considered in future condition assessments. There are additional evidence gaps concerning the nested features, which can be found in the relevant sections of this report.

Table 15. Evidence gaps for the LSIB feature in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see Section 1.1).

Indicator	Assessed status	Comments
Abundance, distribution and species composition of communities (P)	The fish community element did not contribute to the condition outcomes.	• Fish communities were broadly discussed for all SACs using reports including ICES data. Although these reports provide an indication of fish numbers, they have certain limitations. The large area covered makes it unsuitable for specific LSIB or individual SACs. More data would be required to adequately assess fish communities in LSIB.
Invasive non-native species (P)	Low confidence (limited data)	• The spread and impact of the NNS currently present on the LSIB feature within the SAC is not fully understood. More targeted surveys and investigation on the impact of NNS on LSIB are needed. • Investigation into the use of satellite and or aerial imagery for assessing the extent of *G. vermiculophylla* may be beneficial.
Sediment quality: contaminants (S); organic carbon content (S)	Not assessed	• Currently, there is no sediment monitoring within the Menai Strait and Conwy Bay SAC.
Sediment quality: oxidation-reduction profile (redox layer) (S)	Low confidence (limited data)	• The redox layer of sediments was based on current monitoring, but the short time range and small spatial coverage available meant it was difficult to confirm any trend. A larger spatio-temporal dataset is required to fully understand what is happening for all SACs.
Water quality: opportunistic macroalgae (S)	Unknown	• This indicator was assessed as unknown in the Menai Strait and Conwy Bay SAC as most of the overlapping WFD waterbodies were not classified for the opportunistic macroalgae WFD element in the 2024 cycle 3 interim classification. Some WFD waterbodies are not assessed for opportunistic macroalgae as they do not have suitable substratum.

Indicator	Assessed status	Comments
Water quality: turbidity (S)	Unknown	• Turbidity is measured in WFD sampling. As this is limited to only a few samples per year it cannot be used to adequately assess the turbidity. • Investigation of the use of remote sensing data to assess turbidity could be carried out in the future. External data from other organisations could also be used.
Water quality: physicochemical properties (S)	Unknown	• Further evidence on temperature change is required to adequately assess this indicator. Some physicochemical parameters such as salinity and pH have not been assessed. These could be considered in future as some monitoring data are available. • Remote sensing data on temperature, salinity and pH could be used in future.

3.5. Sea caves condition assessment

The sea caves feature in the Menai Strait and Conwy Bay SAC comprises a number of sea caves most of which are along the north Wales coast area of the SAC with only a few within the Menai Strait itself (Figure 13). The summary of the assessment outcome for sea caves is provided in Table 16. These outcomes and any reasons for failure are discussed in more detail in the sections below.

Figure 13. Location map of the sea caves feature in the Menai Strait and Conwy Bay SAC.
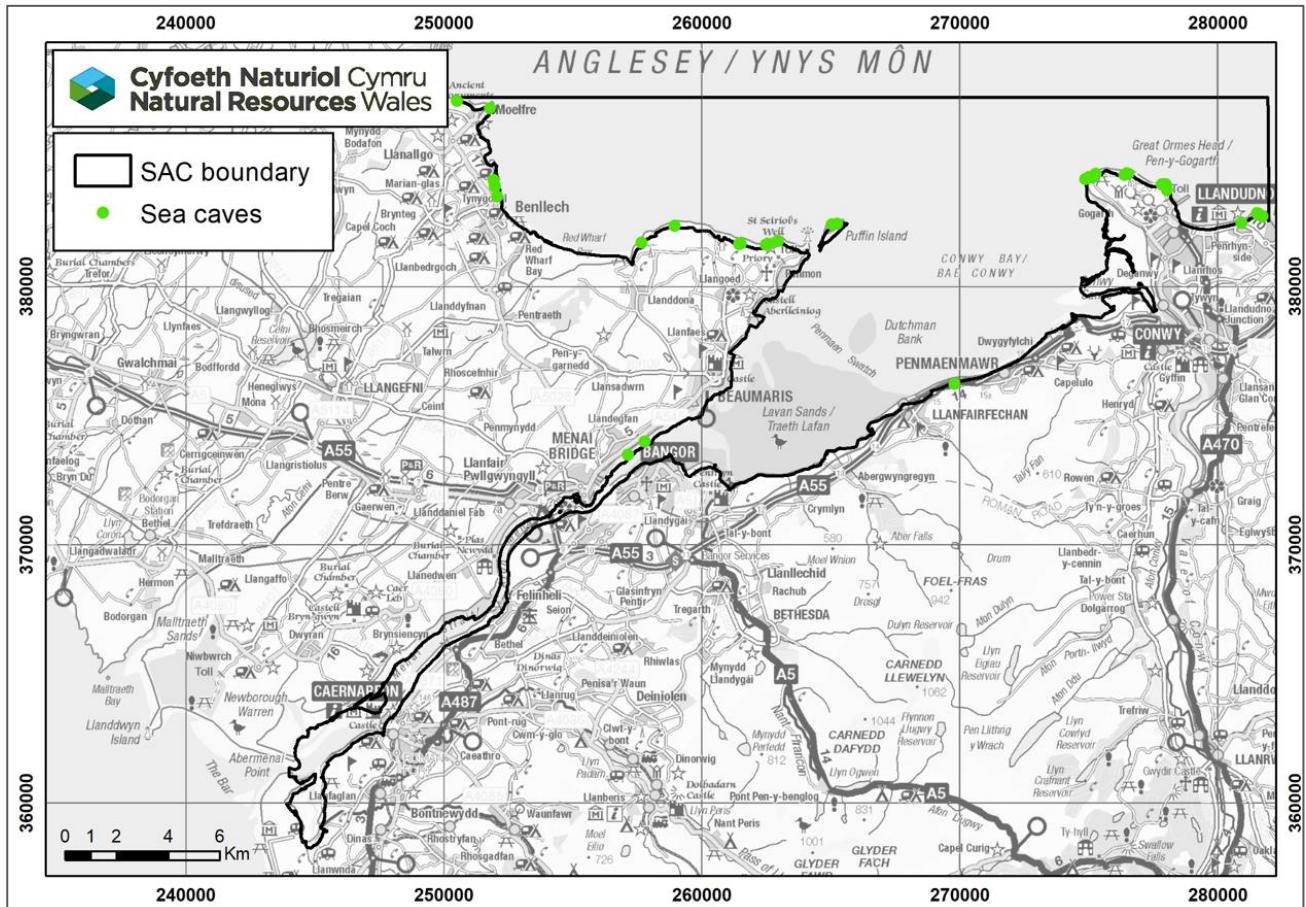
Table 16. Condition assessment of sea caves in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see Section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Extent	No significant decrease in the extent of sea caves within the SAC, allowing for natural change and variation. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the extent of sea caves in the Menai Strait and Conwy Bay SAC. • Confidence is medium as the assessment has not been based on comparison mapping of the feature and expert judgment was used.	**Pass**	Medium
Distribution of the feature	Maintain distribution of sea caves allowing for natural change. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the distribution of sea caves in the Menai Strait and Conwy Bay SAC. • Confidence is medium as the assessment has not been based on comparison mapping of the feature and expert judgment was used.	**Pass**	Medium
Distribution and extent of habitats and communities	Maintain the distribution and extent of sea cave communities, allowing for natural change and variation. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the distribution and extent of habitats and communities of sea caves in the Menai Strait and Conwy Bay SAC. • Confidence is low as expert judgement has been used to assess this indicator in the absence of any recent data from within sea caves.	**Pass**	Low
Bathymetry of the feature	Maintain bathymetry of the sea caves, allowing for natural change and variation. (S)	• There are currently no anthropogenic impacts known to significantly affect the bathymetry of the sea caves at this SAC. • Confidence is low as expert judgement has been used to assess this indicator in the absence of any recent data from within sea caves.	**Pass**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity, allowing for natural variation and change. (S)	• No anthropogenic impacts known to significantly affect the hydrodynamic and sediment transport processes of the sea caves at this SAC. • Confidence is medium as expert judgement has been used to assess this indicator in the absence of recent data.	**Pass**	Medium
Water quality: nutrients (DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (T)	• Two of the WFD waterbodies that overlap with the mapped sea caves feature have been classified as Good or High status for DIN in the 2024 cycle 3 interim classification (Menai Strait and North Wales). • The Anglesey North waterbody was not classified for this WFD element. • Low confidence as one of the waterbodies was not assessed, and as ecological relationships between DIN and sea caves are not fully understood.	**Pass**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: phytoplankton	The WFD classification achieved for phytoplankton should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (T)	• One of the three WFD waterbodies that overlaps with the mapped sea caves was not classified for the phytoplankton WFD element in the 2024 cycle 3 interim classification (Anglesey North). It overlaps with approximately 38% of the mapped sea caves within the SAC. • One WFD waterbody was classified with a High status for phytoplankton (Menai Strait). This classification was rolled forward from the 2018 cycle 2 interim classification. It overlaps with 5% of the mapped sea caves. • The final WFD waterbody was classified with a Moderate status for phytoplankton (North Wales). This waterbody overlaps with the largest proportion of the mapped sea caves (57%). • Confidence is low as one waterbody which overlaps with a large proportion of the feature has not been classified for the phytoplankton WFD element, and as ecological relationships between phytoplankton and sea caves are not fully understood.	**Fail**	Low
Water quality: dissolved oxygen	The WFD classification achieved for dissolved oxygen should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (T)	• All three WFD waterbodies that overlap with the mapped sea caves feature have been classified with High status for dissolved oxygen in the 2024 cycle 3 interim classification. • One WFD waterbody classification was rolled forward from the 2021 cycle 3 classification which affected the confidence. • Confidence is high as most sea caves are high energy environments so likely to have high oxygen levels in general.	**Pass**	High

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: contaminants	Water column contaminants not to exceed the EQS. (T)	• Two of the three overlapping WFD waterbodies have a pass for chemicals in the 2024 cycle 3 interim classification (North Wales and Menai Strait). In both waterbodies the classifications were rolled forward from previous cycles. Combined, they overlap with 62% of the mapped sea caves. • The other WFD waterbody has a fail for chemicals in the 2024 cycle 3 interim classification (Anglesey North). This waterbody failed for mercury and PBDE. It overlaps with 38% of the mapped sea caves. • Confidence is low because the human health standard has been used for PBDE, and the impact of these contaminants on sea caves is unknown.	**Fail**	Low
Water quality: turbidity	Maintain expected levels of turbidity, allowing for natural change and variation. (S)	• There are limited data on turbidity for the sea caves feature in Menai Strait and Conwy Bay SAC, therefore this target was assessed as unknown.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: physicochemical properties	Maintain expected physicochemical properties of the water, allowing for natural change and variation. (T)	• Data from subtidal temperature loggers from within the SAC were available. Loggers at one monitoring site indicated a potential increase in temperature in recent years. It is not clear if this is a localised change or in line with global trends. • An external report from Bangor University indicates that annual mean sea surface temperature is gradually rising in their Menai Strait temperature logger. • It is not understood if the observed increases in temperature are localised to the SAC, or if they are consistent with the effects of climate change. • This indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).	**Unknown**	N/A
Abundance, distribution and species composition of communities	Maintain the abundance, distribution, and diversity of species within communities allowing for natural change and variation. (P)	• No information on sea cave communities has been collected for this SAC since 2000-2002. • Intertidal reefs at this SAC passed for this indicator which may give an indication of how sea caves might be doing in the SAC. • Intertidal reef was not used as a proxy so this indicator has been assessed as unknown.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Species richness and diversity	Maintain the expected richness and diversity of sea cave species, allowing for natural change and variation. (S)	• No information on sea cave communities has been collected for this SAC since 2000-2002. • Intertidal reefs at this SAC passed for this indicator which may give an indication of how sea caves might be doing in the SAC. • Intertidal reef was not used as a proxy so this indicator has been assessed as unknown.	**Unknown**	N/A
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities should not adversely affect the condition of the feature. (P)	• No information on sea cave communities has been collected for this SAC since 2000-2002. • There is also little information on the impact of any INNS present in the SAC on the condition of sea caves.	**Unknown**	N/A
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• No information on sea cave communities has been collected for this SAC since 2000-2002.	**Unknown**	N/A

Assessment conclusions

The sea caves feature in Menai Strait and Conwy Bay SAC has been assessed as being in **unknown** condition (N/A confidence). This was due to the fact that there were very important indicators that could not be assessed as the data were over twenty years old. Two of these indicators were on species composition and species richness (see evidence gaps). There were two tertiary failing indicators (Table 17). A summary of the assessment can be seen in Table 17 with more detail on each performance indicator, and the reasons for indicator failure, provided in the sections below.

For features where an unknown result is recorded a simple assessment was undertaken to see what level of risk the feature might currently be experiencing that could cause it to be in unfavourable condition, if a full assessment were possible.

This simple assessment for sea caves looked at:

- Other indicators assessed in the condition assessment e.g. extent.
- What pressures are present on the SAC or adjacent to the SAC.
- Any other relevant data e.g. other relevant condition assessments.

Seven indicators were assessed as passing in the assessment of condition for sea caves in the Menai Strait and Conwy Bay SAC including extent and distribution. These can be seen in Table 16. The assessment of pressures which might affect the condition of sea caves in the SAC was based on expert judgement.

The following was discussed: there are no major anthropogenic pressures on the SAC that might cause the feature to be unfavourable. However, there were concerns about the accumulation of marine litter, especially in south-west facing caves, but due to the lack of sea cave surveys the scale of this could not be verified. The presence of historical copper mining on the Great Orme and possible effects on the sea caves in that area were discussed but there is no direct evidence of impact. The condition assessment results for intertidal reefs feature at the same SAC was also discussed. On the balance of knowledge of anthropogenic activities in the area and the fact that intertidal reefs in the same SAC passed their species and communities targets it was decided that the sea caves on this SAC were unlikely to be in unfavourable condition.

The sea caves were assessed as being at low likelihood of being in unfavourable condition. The risk assessment was based solely on expert judgment but there was good local knowledge of the SAC so the confidence was judged to be medium (Table 17).

Table 17. Summary of the condition assessment for sea caves in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

Feature	Overall Condition Assessment	Likelihood of unfavourable condition	Indicator failures	Reason for indicator failure	Threats to condition
Sea caves	**Unknown (Confidence not applicable)**	**Low (medium confidence)**	Water quality: phytoplankton (T) Water quality: contaminants (T)	• Phytoplankton failed in the North Wales waterbody. • Levels of mercury and PBDE in the Anglesey North waterbody are failing to meet their relevant EQS.	• Marine Litter • INNS • Recreation • Climate change • Management of coastal defences • Metal mines

Detailed assessment information

Extent and Distribution

The extent, distribution of the feature, and the distribution and extent of habitats and communities indicators in the Menai Strait and Conwy Bay SAC passed their targets as there are currently no known anthropogenic impacts that would negatively affect the sea caves feature. This was based on local knowledge of activities that might affect this feature in the SAC. It should be noted that not all sea caves in this SAC have been mapped. Comparison mapping has not been used to assess the extent and expert judgment was used to assess these indicators in the absence of recent data. This has reduced the confidence to medium.

Bathymetry and hydrodynamic processes

The bathymetry and hydrodynamic and sediment transport processes are not well researched for sea caves. These targets passed with medium confidence based on the knowledge that there are currently no anthropogenic activities that are known to have a significant impact on the sea caves within this SAC.

Water quality

The assessment has considered the sea caves which have been mapped within the SAC however there may be a large number of sea caves which have not been mapped. This affects the WFD waterbodies which have been included, and the proportion of sea caves within those waterbodies, and therefore lowers the confidence in the water quality assessment for this feature. For the mapped sea caves, it has been estimated that all of them fall within three WFD waterbodies where 57% of sea caves overlap with the North Wales waterbody, 38% with the Anglesey North waterbody and 5% with the Menai Strait waterbody.

Nutrients (DIN only) and phytoplankton

The nutrients (DIN only) target was met as two of the relevant overlapping WFD waterbodies were classified with a Good or High status for the DIN element in the 2024 cycle 3 interim classification. These were the Menai Strait and North Wales waterbodies. These waterbody DIN classifications have improved or been maintained. The Anglesey North waterbody was not classified for the DIN element in the 2024 cycle 3 interim classification. This waterbody overlaps with approximately 38% of the mapped sea caves, therefore confidence in the indicator pass was reduced. There is also a lack of knowledge on the impact of nutrients on the sea caves feature, therefore the confidence was reduced to low.

The phytoplankton indicator failed to meet its target as the North Wales waterbody, which overlaps with the largest proportion of the mapped sea caves in the SAC, was classified with a Moderate status for the phytoplankton element in the 2024 cycle 3 interim classification. This waterbody has had a Moderate status for this element since the 2018 cycle 2 interim classification. The Anglesey North waterbody overlaps with the next largest proportion of the mapped sea caves, and has not been classified for phytoplankton in the

2024 cycle 3 interim classification. Classification of some WFD waterbodies is not suitable or possible for this element due to WFD classification methodology, or due to the nature of the waterbodies (e.g. turbidity levels). Confidence in the fail is low as one waterbody which overlaps with a large proportion of the feature has not been classified for the phytoplankton element, and as the ecological relationships between phytoplankton and sea caves are not fully understood.

Dissolved oxygen

The dissolved oxygen indicator met its target as all three relevant WFD waterbodies were classified as High status for the dissolved oxygen element in the 2024 cycle 3 interim classification. Sea caves are high energy environments so likely to have high oxygen levels in general, therefore the confidence in this indicator is high.

Contaminants

One of the three WFD waterbodies that overlap with the mapped sea caves feature in the SAC, Anglesey North, has a fail for chemicals in the 2024 cycle 3 interim classification due to mercury and PBDE. This waterbody overlaps with approximately 38% of the feature, which caused the contaminants indicator to fail. In this waterbody, mercury has failed since the 2015 cycle 2 classification. The EQS for mercury is based on the secondary poisoning protection goal (for wildlife). The PBDE failures were based on the value of the human health protection goal as it is the most stringent. This protection goal may be over precautionary as the effect of contaminants on the biota of sea caves are not fully understood. The confidence in the fail was reduced to reflect this, and as the impact of the failing contaminants on sea cave biota is unknown. The other two overlapping WFD waterbodies have a pass for chemicals in the 2024 cycle 3 interim classification. However, in both waterbodies the classifications were rolled forward from previous cycles as they were not classified in the 2024 cycle 3 interim classification. This also contributed to the low confidence outcome. In addition, the impact of the failing contaminants on the feature are not fully understood.

Turbidity and physicochemical properties

The turbidity indicator was assessed as unknown due to insufficient data. There were some data available from WFD Regulations sampling of suspended particulate matter. However, this is limited to only a few samples per year and therefore cannot be used to adequately assess the turbidity for the sea caves feature.

Data from NRW monitored subtidal temperature loggers from two monitoring sites within the SAC were available. However, as loggers from one of the sites had a large amount of missing data, the observed patterns in temperature are based on data from only one site which does not overlap with the feature but was less than 1km away. These loggers showed an increase in temperature in more recent years. An external report (Smyth et al., 2022) also found that the annual mean sea surface temperature was gradually rising in the Menai Strait. It is not understood if the observed increases in temperature are localised to the SAC, or if they are consistent with the effects of climate change. The physicochemical indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).

Species and communities

No information on sea cave communities has been collected for this SAC since 2000-2002. The majority of caves within the Menai Strait and Conwy Bay SAC occur along the limestone coast of the Great Orme's Head and Little Orme's Head, however there are shallow intertidal caves in several other locations including the north side of Puffin Island and the mainland coast of Anglesey between Puffin Island and Llanddonna.

The cliffs of the Great and Little Orme's headlands are composed of carboniferous limestone, as is the area around Puffin Island. Wave action on the limestone here has formed cave and overhang features both in the intertidal and subtidal. The caves range from wave-cut indentations in the base of the cliffs to fully formed caves and tunnels, some over 30 m long.

The cave floors are typically scoured smooth and barren and the upper parts of the walls at the cave rear are covered in a thin brown biotic film with a few small mussels *Mytilus edulis* and barnacles occurring in algal crusts and films dominate the main part of the cave walls. Below these crusts are dense zones of barnacles, tubeworms and mussels. In places the vertical walls descend to overhangs dominated by large clumps of mussels with barnacles and the plumose anemone *Metridium senile*. Beneath the overhangs, a scour zone at the base of the rock walls has sparse barnacles and tubeworms often with an overlying short turf of the hydroid *Obelia dichotoma* (Bunker and Holt, 2003).

The biotopes and their characterising species found in the cave systems in the Menai Strait and Conwy Bay SAC are highly representative of the limestone substrata/habitat and the turbid waters. The most abundant species are those resilient to high and almost constant turbidity and the effects of sand-scour, and as such assemblages of species not often recorded in the rest of the Wales and the UK occur here (Bunker and Holt, 2003).

Intertidal reefs at this SAC passed for this indicator which may give an indication of how sea caves might be doing in the SAC. However, intertidal reef was not used as a proxy so this indicator has been assessed as unknown.

Invasive non-native species

There is no information available on the establishment or impact of non-native species in sea caves in this SAC as there have been no surveys within the sea caves since 2000-2002. For this reason the INNS and NNS targets were assessed an unknown.

There has been an increase in the number of records for *Crepidula fornicata* identified in the Menai Strait and Conwy Bay SAC. Other non-native species (NNS) are known to be present in the Menai Strait (within the reefs feature) including *Ostrea chilensis*, *Magallana gigas* and *Sargassum muticum*. Limited records have been produced for *O. chilensis*, but it has been known to be present in the Menai Strait for about 30 years. It is not fully understood how any NNS present could impact the sea cave biota and any potential effects on the species diversity and composition are unknown.

Reasons for target failure

The assessment of the sea caves feature in Menai Strait and Conwy Bay SAC failed two tertiary targets. There were also six targets that were assessed as unknown due to limited data availability. Overall the feature was assessed to be in unknown condition. The failing indicators and reasons for failure, if known, are stated below.

Water quality: phytoplankton

This indicator target has a tertiary weighting. The failure of the phytoplankton indicator is due to the Moderate status classification for this element in the North Wales waterbody in the 2024 cycle 3 interim classification. The 2021 WFD investigation of the failures in this waterbody has been carried out and concluded that the 2021 cycle 3 classification was likely a result of diatom blooms in the first part of 2016, and the pattern of high phytoplankton was not repeated in subsequent years. There are mitigation measures in place in catchments adjacent to the North Wales waterbody, but it has not been possible to determine if these have reduced nutrient inputs into the waterbody recently.

Water quality: contaminants

This indicator target has a tertiary weighting. The sea caves feature is partly within one WFD waterbody, Anglesey North, which has failed for chemicals due to mercury and PBDE. Historically, the main source of PBDE is as flame retardants in a variety of materials (Viñas et al., 2022). Mercury has been used in many industries, but today the primary sources are burning of coal and artisan mining for mercury (Larsen and Hjermann, 2022).

Some of the contaminants in the water column may be derived from diffuse sources including atmospheric deposition or contaminated waterbody bed sediments. However, the WFD investigation of the failure is yet to be undertaken. Mercury and PBDE are being managed in the UK and it is hoped that these levels will reduce in time.

Threats to condition

Part of the condition assessment is to identify threats to the condition of the sea caves. A threat is defined as an activity that is currently not impacting condition but has the potential to do so over the next reporting cycle, if activity levels increase or are unmanaged. It is important to identify these threats to be able to put pre-emptive management in place to prevent declines in condition.

Activities that go through licencing and permission process e.g. offshore wind and marine cabling, whereby the impact of the activity on the feature would be assessed have not been included. The threats to the sea caves feature condition in the Menai Strait and Conwy Bay SAC are stated below.

Recreational access and collection

Access for recreational activities particularly coasteering can have a trampling effect on intertidal sea caves. This could have detrimental impact on the sea cave communities.

Invasive non-native species

Invasive non-native species are a threat to most of the features in the Welsh SACs. The impact of INNS on the sea caves feature is not well understood, and as they are mostly shady environments many of the invasive seaweeds are unlikely to be an issue. However, some INNS such as *Magallana gigas* could outcompete other sea cave organisms particularly near cave mouths.

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. The SACs could be at risk since there are a number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Management of coastal defences

The State of the UK Climate 2023 Report highlights an observed acceleration in rates of climate induced sea-level rise which, along with storm surges can cause coastal erosion and flooding (Kendon et al, 2024). Shoreline Management Plans identify the preferred approach to coastal management in light of climate change, which includes maintaining or upgrading defences in some areas and adapting the approach to management in others. Where defences continue to be maintained, there are potential impacts on coastal processes and associated habitats and species.

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counter act each other. However, threats from climate change may include (Gihwala et al., 2024; Oaten et al., 2024):

- Sea level rise, leading to coastal squeeze and loss of extent for some SACs.
- Changes in air and sea temperature,
- Changes in ocean acidification,
- Changes to wave climate, especially storm frequency and intensity.

Marine litter

Caves especially south-west facing caves are known to accumulate marine litter. This litter can breakdown and cause smothering and leaching effects on sea cave communities. The scale of the issue in the SAC is unknown but is definitely a threat.

Historic Metal Mines

In the Menai Strait and Conwy Bay SAC there are historic metal mines which could have an effect on the sea cave communities. This is due to leaching from the old mines in the back of sea caves. More information on this issue would be useful.

Evidence gaps

There are gaps in the current evidence that NRW feel are needed to be filled to fully understand condition in this feature.

Listed below (Table 18) are current indicators that were either assessed as unknown, not assessed, or assessed with a lower confidence. This was due to either limited data availability, outdated data, or a lack of information. Some indicators are not currently monitored but should be ideally considered in future condition assessments.

Table 18. Evidence gaps for sea caves in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see Section 1.1).

Indicator	Assessed status	Comments
Distribution and extent of habitats and communities (P)	Low confidence (proxy data used)	• There are currently no data available to assess changes for these indicators from within sea caves across all SACs. Assessment was based on expert judgment.
Abundance, distribution and species composition of communities (P); species richness and diversity (P)	Unknown	• There are no current data available to assess this indicator for sea caves across all SACs.
Invasive non-native species (P); non-native species (T)	Unknown	• Investigations into the impact of the recorded NNS on sea caves is required. • There have been no targeted surveys for NNS in sea caves across all SACs.
Water quality: turbidity (S)	Unknown	• Turbidity is measured in WFD sampling, but this is limited to only a few samples per year. Therefore, this cannot be used to adequately assess the turbidity. • Investigation of the use of remote sensing data to assess turbidity could be carried out in the future. External data from other organisations could also be used.
Water quality: physicochemical properties (S)	Unknown	• Further evidence on temperature change is required to adequately assess this indicator. Some physicochemical parameters such as salinity and pH have not been assessed. These could be considered in future as some monitoring data are available. • Remote sensing data on temperature, salinity and pH could be used in future.

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