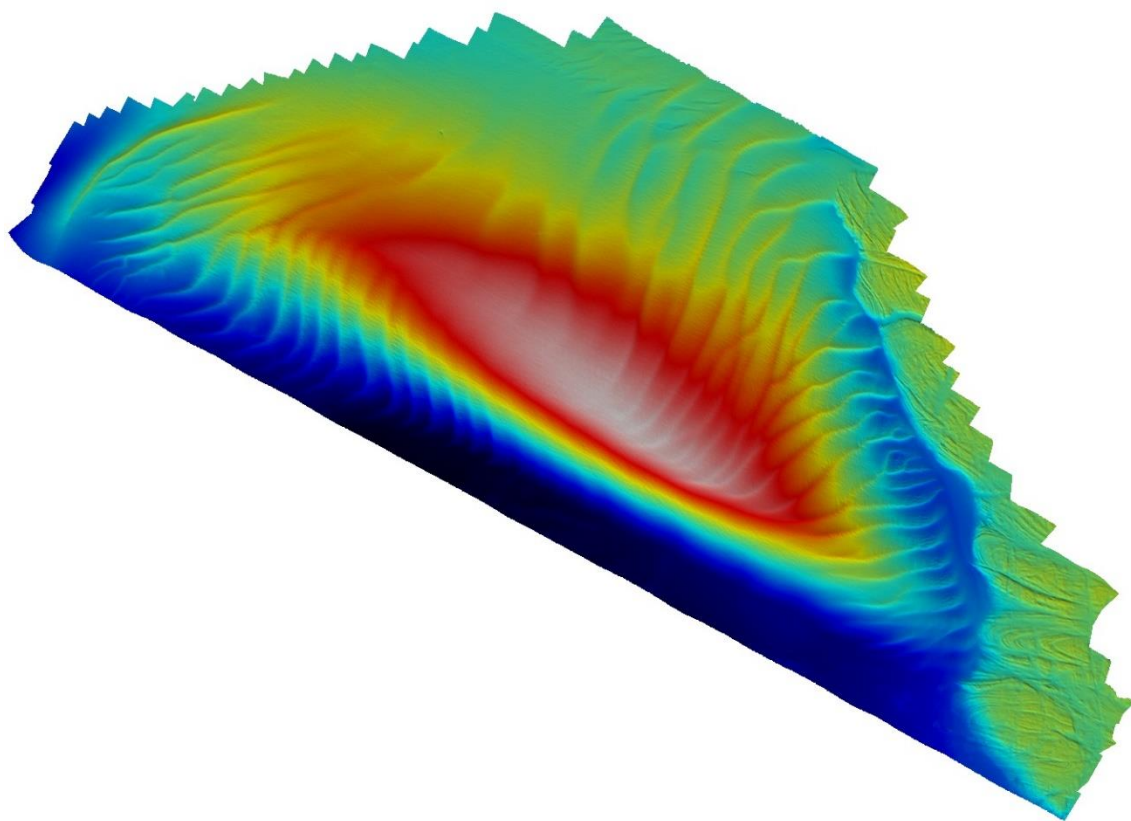# Condition Assessments for Sandbanks which are slightly covered by seawater all the time in Welsh Special Areas of Conservation

Report No: 902

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Turbot Bank © Mike Camplin (NRW)

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- Securing our data and information;
- Having a well resourced proactive programme of evidence work;
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Approved By: Winterton, A.

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Contents

List of Figures

List of Tables

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 ponciau tywod sydd fymryn dan ddŵr y môr drwy'r amser o fewn ardaloedd cadwraeth arbennig dynodedig (ACA) ledled Cymru. Mae Adran 1 yn rhoi trosolwg o'r broses asesu ac mae Adran 2 yn darparu disgrifiad a lleoliad y nodwedd(ion).

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 yr IMCA.

Crynodeb o asesiadau cyflwr ar gyfer ponciau tywod sydd fymryn dan ddŵr y môr drwy'r amser mewn ACAau ledled Cymru

Lleoliad y nodwedd ACA	Asesiad cyflwr	Hyder yn yr asesiad
Y Fenai a Bae Conwy	Anffafriol	Canolig
Pen Llŷn a'r Sarnau	Ffafriol	Canolig
Bae Caerfyrddin ac Aberoedd	Ffafriol	Canolig
Sir Benfro Forol	Ffafriol	Canolig
Bae Ceredigion	Ffafriol	Canolig

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 sandbanks feature within designated special areas of conservation (SACs) across Wales. Cross-border sites are not included in this report but will hopefully be considered in future. Section 1 gives an overview of the assessment process and Section 2 provides a description and location of the feature(s).

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 sandbanks in SACs across Wales.

Name of SAC	Condition assessment	Confidence in assessment
Menai Strait and Conwy Bay	Unfavourable	Medium
Lleyn Peninsula and the Sarnau	Favourable	Medium
Carmarthen Bay and Estuaries	Favourable	Medium
Pembrokeshire Marine	Favourable	Medium
Cardigan Bay	Favourable	Medium

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. Cross-border sites are not included in the assessment report due to resource limitations, but NRW hopes to take forward cross-border sites condition assessments in the future.

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. Feature description

The following text is the habitat description from the JNCC list of Annex I marine, coastal and halophytic habitats.

"Annex 1 sandbanks which are slightly covered by sea water all the time (1110) (sandbanks) consist of sandy sediments that are permanently covered by shallow sea water, typically at depths of less than 20 m below chart datum (but sometimes including channels or other areas greater than 20 m deep). The habitat is comprised of distinct banks (i.e. elongated, rounded or irregular 'mound' shapes) which may arise from horizontal or sloping plains of sandy sediment. Where the areas of horizontal or sloping sandy habitat are closely associated with the banks, they are included within the Annex I type.

The diversity and types of community associated with this habitat are determined particularly by sediment type together with a variety of other physical, chemical and hydrographic factors. These include geographical location (influencing water temperature), the relative exposure of the coast (from wave-exposed open coasts to tide-swept coasts or sheltered inlets and estuaries), the topographical structure of the habitat, and differences in the depth, turbidity and salinity of the surrounding water. Within the UK's inshore waters sandbanks can be categorised into four main sub-types: gravelly and clean sands, muddy sands, eelgrass *Zostera marina* beds, and maerl beds (composed of free-living Corallinaceae). The latter two sub-types are particularly distinctive and are of high conservation value because of the diversity of species they may support and their general scarcity in UK waters."

Some sandbanks in Wales were designated prior to the feature description being clarified and therefore do not fully conform to the feature description. The two sub-types of high conservation value are not found as part of any sandbanks feature in Welsh SACs.

More information can be found on the JNCC website.

3. Sandbanks condition assessments

This section contains assessments for all designated sandbanks in Welsh only marine ardal cadwraeth arbennig (ACA) / special areas of conservation (SAC). The designated sandbanks are spread across five SACs in Wales (Figure 1):

- Y Fenai a Bae Conwy / Menai Strait and Conwy Bay
- Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau
- Caerfyrddin ac Aberoedd / Carmarthen Bay and Estuaries
- Sir Benfro Forol/ Pembrokeshire Marine
- Bae Ceredigion / Cardigan Bay.

More information on the SACs and their features can be found in NRW's conservation advice on our website.

There are 10 individually monitored sandbanks across five SACs in Wales, data from these sandbanks were used in the assessment.

Sandbanks have been assessed against the chosen performance indicators. Any gaps in evidence that would improve the assessment of condition have been identified for each SAC (Section 4).

The indicators were assessed using a combination of NRW Habitats Regulations monitoring, Water Framework Directive (WFD) Regulations 2017 (WFD Regulations) monitoring, commissioned evidence reports, plan and project assessments, scientific literature, 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.

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.

Figure 1. Location of SACs assessed for the sandbanks feature.
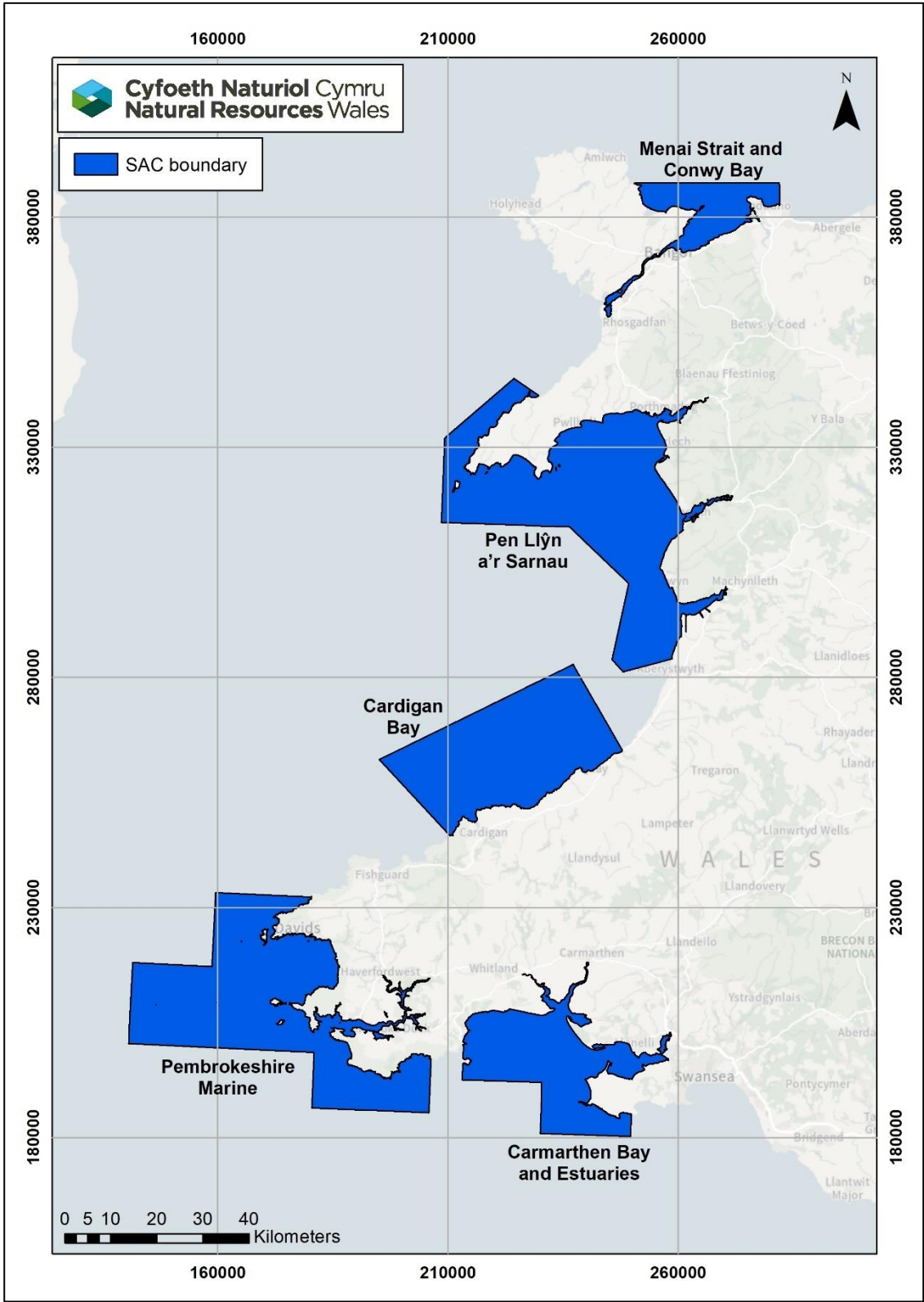
3.1. Menai Strait and Conwy Bay SAC

The sandbanks feature in Menai Strait and Conwy Bay SAC comprises a number of sandbanks (Figure 2). 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 2. Map of the sandbanks feature in Menai Strait and Conwy Bay SAC.
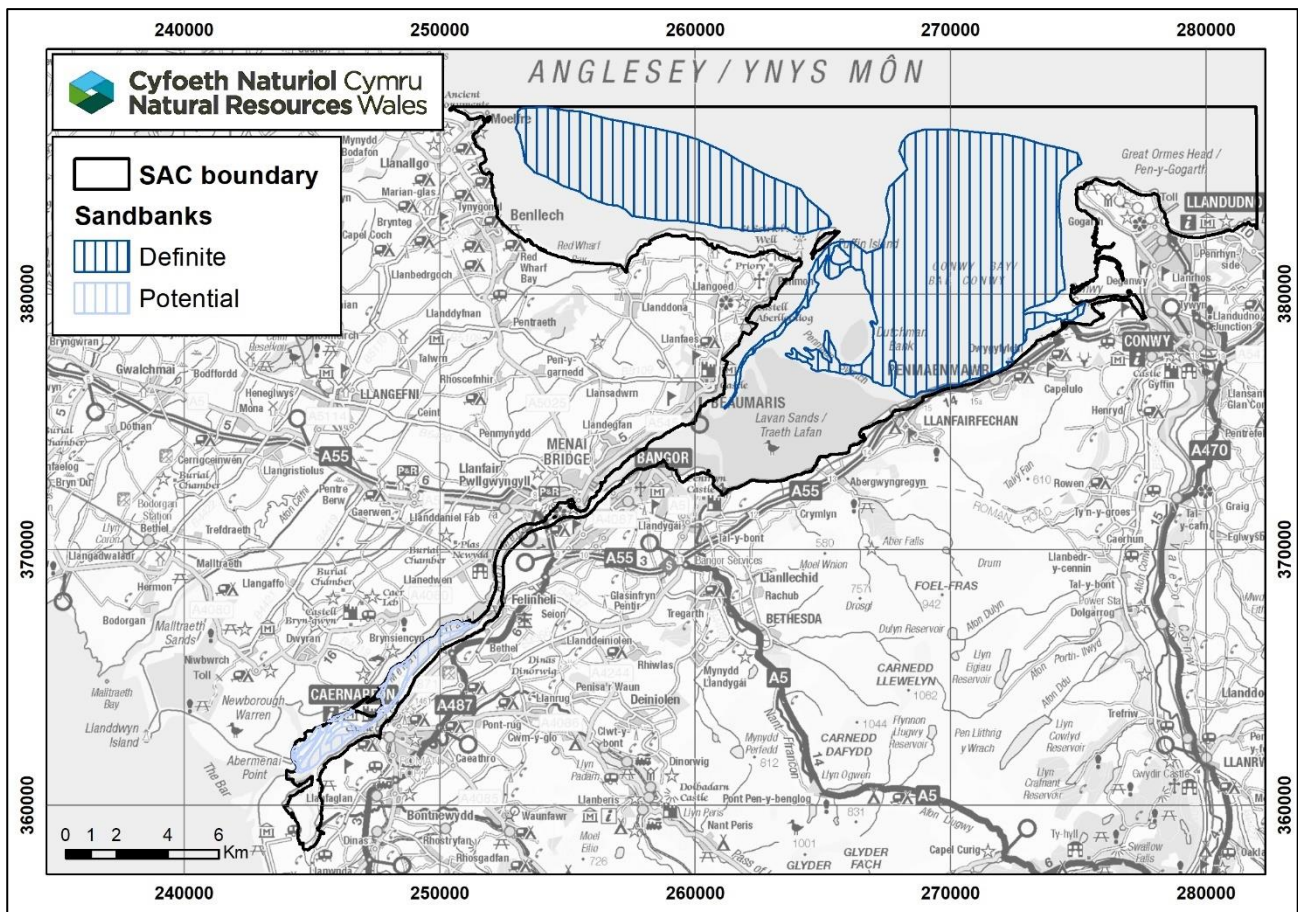
The summary of the assessment outcome is provided in Table 2. These outcomes and reasons of failure are discussed in more detail in the sections below.

Table 2. 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 (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. (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. ○ 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 environmental quality standards (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, polybrominated diphenyl ethers (PBDE), polycyclic aromatic hydrocarbons (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 Infaunal Quality Index (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. American slipper limpet *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 3). There were limited or absent data for one key indicator to inform on the condition of the feature (see evidence gaps section 4). 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 3).

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 sandbanks in Menai Strait and Conwy Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Menai Strait and Conwy Bay	**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 environmental quality standards (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 3. Map of the localised failure in the sandbanks feature in Menai Strait and Conwy Bay SAC.
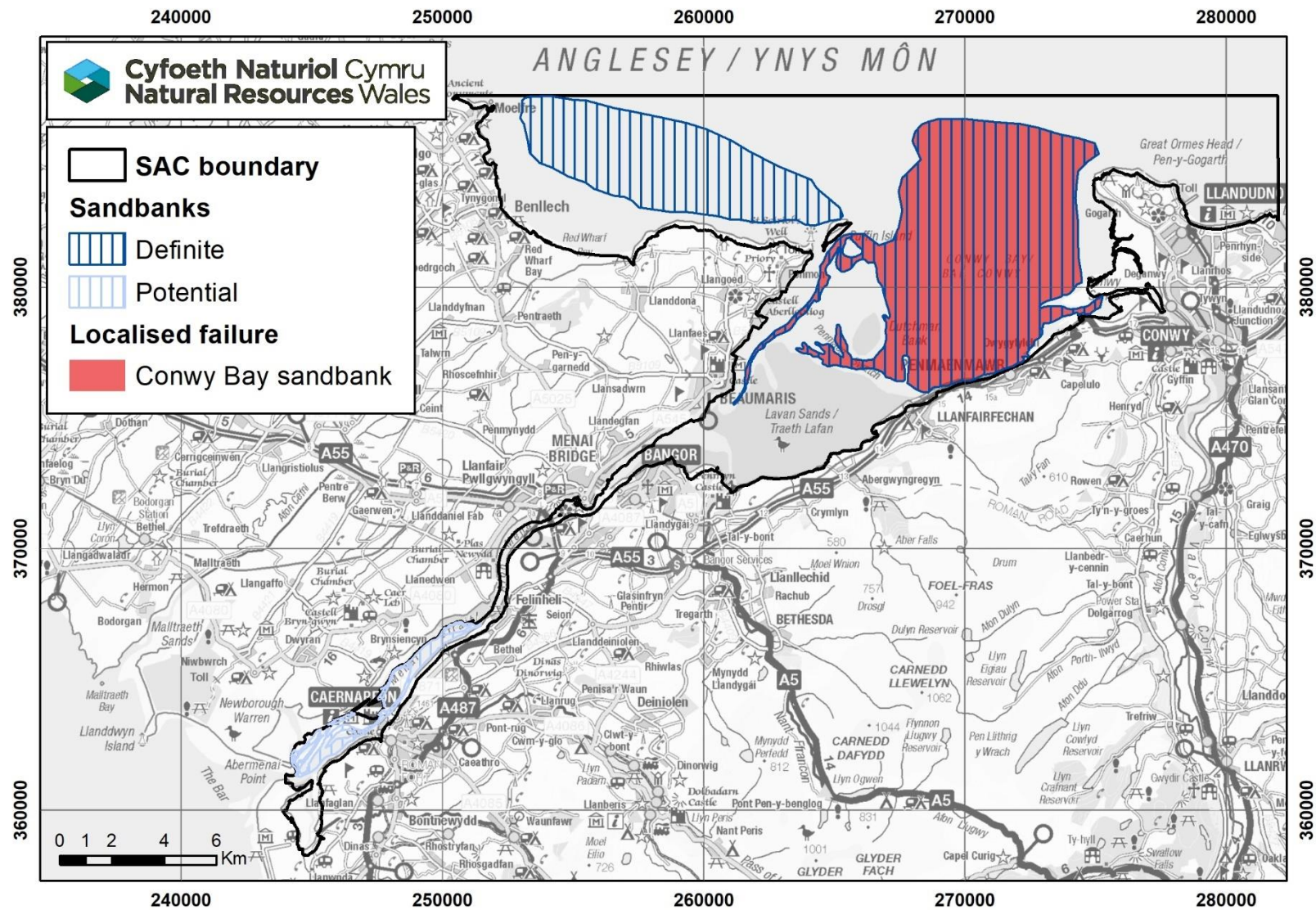
Detailed assessment information

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. 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 (Dissolved Inorganic Nitrogen (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 (see Section 3). 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 (polycyclic aromatic hydrocarbons (PAH)), Anglesey North (mercury and polybrominated diphenyl ethers (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 Infaunal Quality Index (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). 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 non-native species (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 the American slipper limpet *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 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 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 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 sandbanks feature. 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 Per- and polyfluoroalkyl substances (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.

3.2. Pen Llyn a'r Sarnau SAC

The sandbanks feature in Pen Llŷn a`r Sarnau SAC comprises a number of sandbanks (Figure 4). The NRW Habitats Regulations monitoring has focussed on three named sandbanks within the SAC: Tripods, Bastram Shoal and Devils Ridge. These sandbanks have been assessed together against the performance indicators and an overall condition was assigned for the feature.

Figure 4. Map of the sandbanks feature in Pen Llŷn a`r Sarnau SAC.
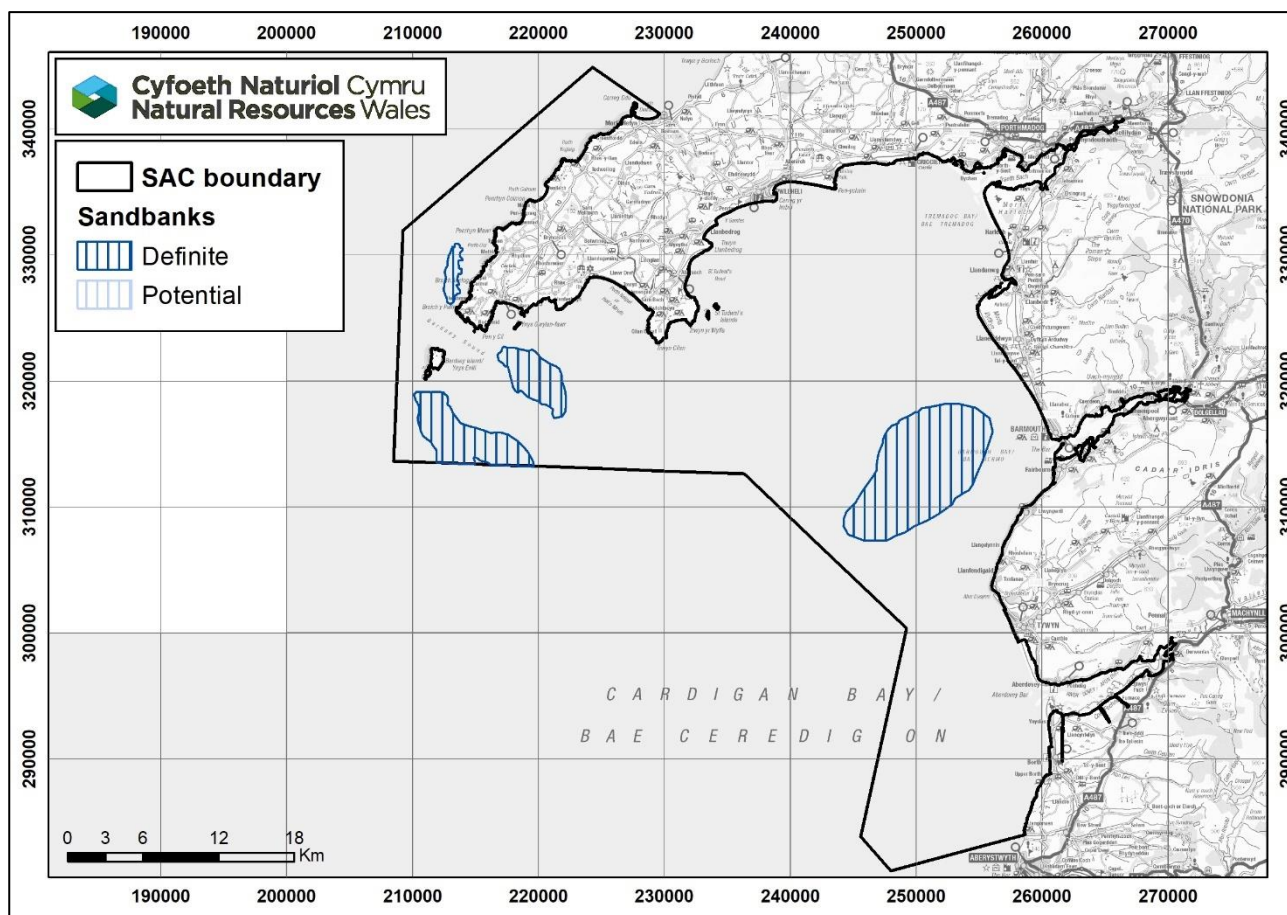
The summary of the assessment outcome is provided in Table 4. These outcomes and reasons of failure are discussed in more detail in the sections below.

Table 4. Condition assessment of sandbanks in Pen Llŷn a`r Sarnau 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 Pen Llŷn a`r Sarnau 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 Pen Llŷn a`r Sarnau 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 for the three monitored sandbanks showed some changes in sediment composition but this is likely to be natural. • Confidence is high due to the availability of long term monitoring data and lack of concerning patterns.	**Pass**	High
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of the sandbanks. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of sandbanks in the Pen Llŷn a`r Sarnau SAC. • Confidence is medium as the assessment has been based on expert judgment.	**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 Pen Llŷn a`r Sarnau 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)	• Both of the WFD waterbodies that overlap with the sandbanks feature have been classified with a High status for DIN in the 2024 cycle 3 interim classification (Cardigan Bay North and Caernarfon Bay South). Combined, these waterbodies overlap with 65% of the feature. • Confidence is high as there were no WFD waterbodies that overlap with the feature that were not classified or failed for the DIN element.	**Pass**	High
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)	• Both of the overlapping WFD waterbodies have been classified with a Good or High status for phytoplankton in the 2024 cycle 3 interim classification (Cardigan Bay North and Caernarfon Bay South). • Confidence is medium as the ecological relationships between phytoplankton and the sandbanks feature are not well understood.	**Pass**	Medium

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. (S)	• Both WFD waterbodies that overlap with the sandbanks feature have been classified with a High status for dissolved oxygen in the 2024 cycle 3 interim classification. • Confidence is medium due to samples being taken from surface of waterbody.	**Pass**	Medium
Water quality: contaminants	Water column contaminants not to exceed the EQS. (S)	• One of the two WFD waterbodies was not classified as the chemicals have not been assessed within the last six years (Caernarfon Bay South). This waterbody overlaps with 2% of the feature. • The other WFD waterbody has a fail for chemicals (Cardigan Bay North). This waterbody failed mercury and PBDE. It overlaps with 63% of the feature. • Confidence is medium as the human health standard has been used for PBDE and one waterbody has not been classified.	**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 Pen Llŷn a`r Sarnau 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 the six subtidal temperature loggers from within the SAC were available. Some of the loggers indicated an increase in the number of days with higher temperatures, and some showed no clear pattern. • 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)	• Both overlapping WFD waterbodies were classified as Good status for the IQI WFD element in the 2024 cycle 3 interim classification (Cardigan Bay North and Caernarfon Bay South). Combined, these waterbodies overlap with 65% of the feature. • Analysis of macrobenthic infaunal communities for the three sandbanks assessed showed large variation across monitoring stations and years with recent shift towards earlier communities. • Confidence is medium as the changes observed are unexplained and it is not known whether this is due to natural, methodological or anthropogenic causes.	**Pass**	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 showed an increase in diversity since 2011 for Tripods and Devils Ridge but, an unexplained decline in diversity for Bastram Shoal in recent years (2018, 2021). • Species richness increased over time since the initial drop following 2001 for Tripods and Devils Ridge sandbanks and after 2012 for Bastram Shoal. • Confidence is medium due to uncertainties around the recent decline in diversity at Bastram Shoal.	**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 three sandbanks remained stable and within the expected values over the monitoring period. • Confidence is high due to the availability of high quality monitoring data and lack of concerning patterns in recent years.	**Pass**	High
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 are currently impacting the condition of sandbanks in the SAC. • Confidence is medium as whilst there have been no new records of NNS in the last six years, there have been no targeted surveys of NNS and the spread and impacts of any INNS present within the feature are not well understood.	**Pass**	Medium
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• There are no new NNS records across all the three monitored sandbanks within the last six years. • Confidence is medium because there have been no targeted surveys of NNS on sandbanks.	**Pass**	Medium

Assessment conclusions

The sandbanks feature in Pen Llŷn a`r Sarnau SAC has been assessed as being in **favourable** condition (medium confidence). Overall, the lack of any significant anthropogenic impact on this feature in terms of extent, hydrodynamic processes, topography, sediment composition and its associated community, have contributed to this favourable assessment outcome. There was a failure for one secondary target (Table 5) and there were limited or absent data for one key indicator to inform on the condition of the feature (see evidence gaps section 4). This reduced the confidence in the assessment.

A summary of the assessment can be seen in Table 5 with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 5. Summary of the condition assessment for sandbanks in Pen Llŷn a`r Sarnau SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Pen Llŷn a`r Sarnau	**Favourable (medium confidence)**	Water quality: contaminants (S)	• Levels of mercury and PBDE in the Cardigan Bay North waterbody are failing to meet their relevant EQSs.	• INNS • Water quality: contaminants • Climate change

Detailed assessment information

Tripods, Devils Ridge and Bastram Shoal, which are part of the sandbanks feature in the Pen Llŷn a`r Sarnau SAC, were monitored in 2001 and then every three years between 2009-2021 using grab sampling surveys.

Extent and distribution

The indicators for extent and distribution of the sandbanks feature in Pen Llŷn a`r Sarnau SAC pass the target as there are currently no known anthropogenic impacts that would significantly affect the sandbanks feature. Sandbanks within the SAC were mapped using bathymetry in 2016, but no further measurements were taken. As repeat data are not available, it is not possible to make any comparison of extents over time in order to calculate change. 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

Granulometric analysis indicated some variations in sediment composition particularly fluctuating between 250-500 µm (medium sand) and 500-1000 µm (coarse sand) grain size. This variation could be explained by the topography of a sandbank. Sample stations are in fixed positions but sandwaves move across the bank over time. This means that sometimes samples may be collected from the peak of a sandwave and sometime from the trough and flanks, which could explain the variation in grain size. Bathymetry images of the sandbank would help further understand these topographic changes, and whether they are responsible for variation in sediment grain size. The 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. The sediment composition and distribution indicator met its target based on the knowledge that there were no anthropogenic activities nearby that could significantly impact the sandbank sediment. Confidence in the pass is high due to the availability of long term monitoring data and lack of concerning patterns or changes in sediment composition.

The topography and hydrodynamic and sediment transport processes are not well researched for sandbanks. These indicator targets were 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 Pen Llŷn a`r Sarnau SAC.

Water quality

It has been estimated that approximately 65% of the sandbanks feature within the SAC falls within two WFD waterbodies, therefore these are likely to be a good reflection of the overall effect of water quality on feature. The Cardigan Bay North waterbody overlaps with the largest proportion of the feature (63%).

Nutrients (DIN only) and phytoplankton

The indicator for nutrients (DIN only) met its target with a high confidence as both of the WFD waterbodies that overlap with the feature were classified with a High status for the DIN element in the 2024 cycle 3 interim classification.

The phytoplankton indicator met the target as both of the overlapping WFD waterbodies were classified with a Good or High status for phytoplankton in the 2024 cycle 3 interim classification. Confidence was reduced to medium as the ecological relationships between phytoplankton and the sandbanks feature are not well understood.

Dissolved oxygen

The dissolved oxygen indicator met its target. Confidence in the pass was reduced to medium because surface sampling of dissolved oxygen may not detect issues for more demersal features (see further detail in section 3.1).

Contaminants

One of the two WFD waterbodies that overlaps with the sandbanks feature has a fail for chemicals in the 2024 cycle 3 interim classification. The failures were in the Cardigan Bay North waterbody, which failed for mercury and PBDE. This waterbody overlaps with the largest proportion of the feature (63%), which caused the contaminants indicator to fail. The EQS for mercury is based on the secondary poisoning protection goal (for wildlife). The human health protection goal that is used for PBDE may be considered as over precautionary as the effect of contaminants on the biota of sandbanks are not fully understood. The other WFD waterbody, Caernarfon Bay South, was not classified as the chemicals have not been assessed within the last six years. The confidence in the failure was reduced to medium due to this and because the human health standard has been used for PBDE. 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 six NRW monitored subtidal temperature loggers within the SAC were available. None of the loggers overlap with the sandbanks feature, but three of the six loggers are within 3 km of sandbanks. Some of the loggers indicated an increase in the number of days with higher temperatures, and some showed no clear pattern. 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

Both of the overlapping WFD waterbodies were classified as Good status for the IQI element in the 2024 cycle 3 interim classification (Cardigan Bay North and Caernarfon Bay South). Combined, these waterbodies overlap with 65% of the sandbanks feature.

Infaunal analysis showed that the species comprising the communities present in the three monitored sandbanks varied widely. There have been some noticeable changes, which are unexplained but there is no evidence to suggest these are attributable to anthropogenic activity. These changes have lowered the confidence to medium in the pass for the abundance, distribution and species composition of communities indicator.

There was a large decline in species richness from 2001 to 2012 seen across the three sandbanks. Species richness has appeared to recover, however, and has continued to increase above previous levels seen in 2001 for Tripods and Bastram Shoal. Diversity followed the same pattern with a decline in 2009 and subsequent increase in recent years for Tripods and Devils Ridge. The diversity at Bastram Shoal sandbank tended to vary a lot over time but indicated a decrease in recent years (2018, 2021), causing some uncertainty. This has reduced the confidence in the indicator pass for species richness and diversity to medium.

In the three most recent monitoring years (2015, 2018 and 2021) the average taxonomic distinctness for Bastram Shoal (analysis based on wider species list) was within the expected levels. The average taxonomic distinctness for the other two monitored sandbanks remained stable and within the expected values over the monitoring period. This resulted in a pass for the taxonomic spread of species indicator with high confidence.

Invasive non-native species

The polychaete *Goniadella gracilis,* a low impact species, was first recorded within the sampling stations in Tripods sandbank in 2001 and has subsequently been found every year in low abundance in Bastram Shoal. No new NNS were recorded in the sandbanks feature within the last six years, resulting in the NNS indicator to meet its tertiary target. Confidence in the pass was reduced to medium as there have been no targeted surveys for NNS on sandbanks.

It is not fully understood how this 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 any INNS present the primary target of the INNS indicator passed. Confidence was reduced to medium as whilst there have been no new records of NNS in the last six years, there have been no targeted surveys of NNS, and the spread and impacts of any INNS present within the feature are not well understood.

Reasons for target failure

The sandbanks feature in Pen Llŷn a'r Sarnau SAC has been assessed as being in **favourable** condition. However, one secondary target failed to be met and needs to be kept under review.

Water quality: contaminants

This indicator target has a secondary weighting. A large proportion of the sandbanks feature in the SAC overlaps with one WFD waterbody, Cardigan Bay North, which has a fail for chemicals due to PBDE and mercury. 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).

The exact sources of mercury and PBDE into the Cardigan Bay North waterbody are unknown. A WFD investigation of the failures 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 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 Pen Llŷn a`r Sarnau SAC are stated below.

Invasive non-native species

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

There have been confirmed records of *C. fornicata* within the Pen Llŷn a`r Sarnau SAC. There are currently no recorded observations of the species on the sandbanks feature. At high densities, this species could cause an impact on the feature (see further detail in section 3.1).

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 SAC 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.

3.3. Cardigan Bay SAC

The sandbanks feature in Cardigan Bay SAC comprises a number of sandbanks (Figure 5). The NRW Habitats Regulations monitoring has focussed on one unnamed sandbank within the SAC. This sandbank has been assessed against the performance indicators and an overall condition was assigned for the feature.

Figure 5. Map of the sandbanks feature in Cardigan Bay SAC.
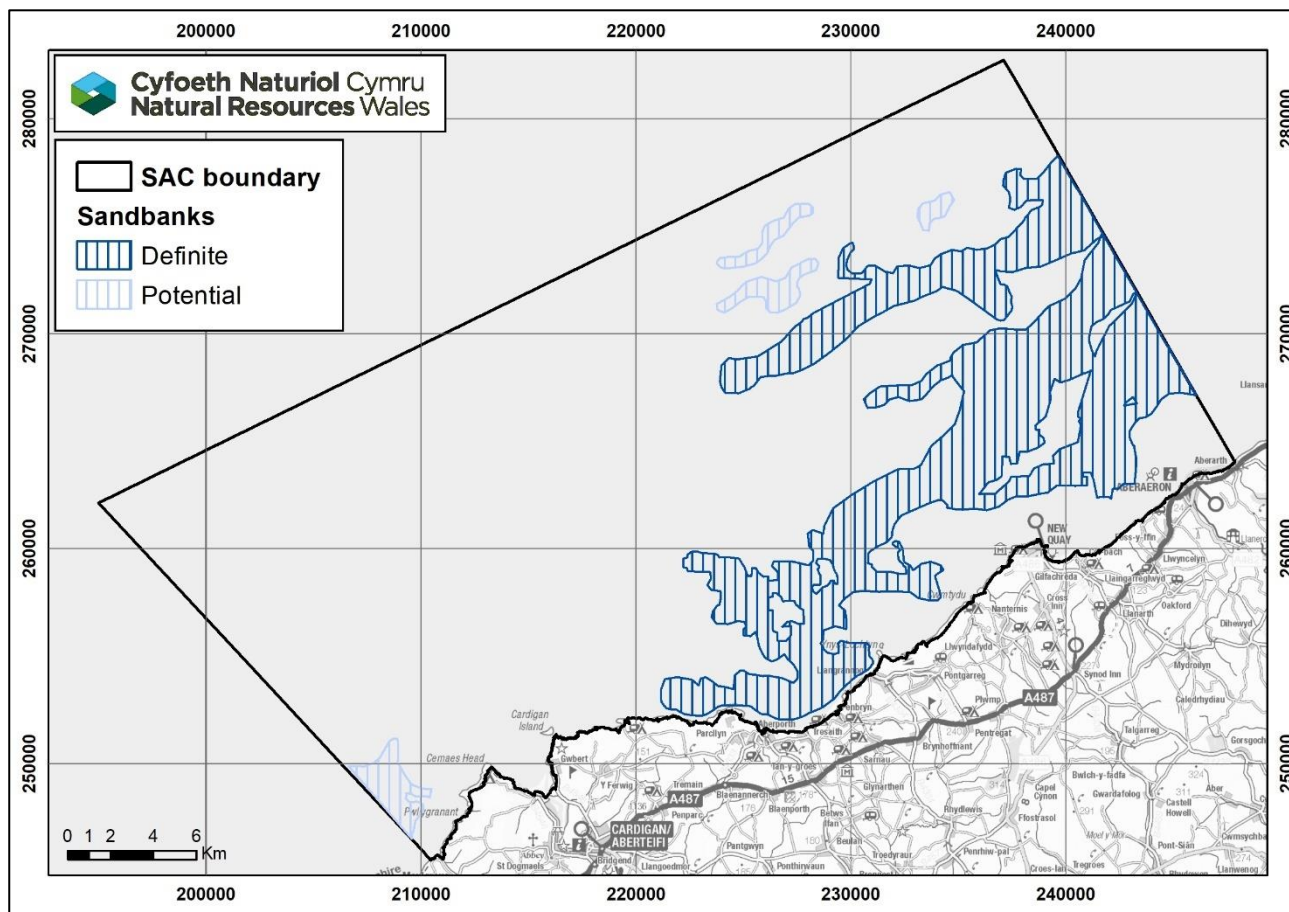
The summary of the assessment outcome is provided in Table 6. These outcomes and reasons of failure are discussed in more detail in the sections below.

Table 6. Condition assessment of sandbanks in Cardigan 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 Cardigan 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 Cardigan 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 for the monitored sandbank showed some changes in sediment composition with mixed sediment type but this is likely to be natural. • Confidence is high due to the availability of long term monitoring data and lack of concerning patterns.	**Pass**	High
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of the sandbanks. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of sandbanks in the Cardigan Bay SAC. • Confidence is medium as the assessment has been based on expert judgment.	**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 sandbanks in the Cardigan 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)	• The sandbanks feature is offshore and does not overlap with any WFD waterbodies. • The adjacent Cardigan Bay Central waterbody was used for the assessment. This waterbody was classified as High status for DIN in the 2024 cycle 3 interim classification. • Confidence in the pass is medium as there is no direct overlap with the feature.	**Pass**	Medium
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)	• The sandbanks feature is offshore and does not overlap with any WFD waterbodies. • The adjacent Cardigan Bay Central waterbody was used for the assessment. This waterbody was classified as High status for phytoplankton in the 2024 cycle 3 interim classification. • Confidence in the pass is medium as there is no direct overlap with the feature.	**Pass**	Medium

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. (S)	• The sandbanks feature is offshore and does not overlap with any WFD waterbodies. • The adjacent Cardigan Bay Central waterbody was used for the assessment. This waterbody was classified as High status for dissolved oxygen in the 2024 cycle 3 interim classification. • Confidence is low as there is no direct overlap with the feature and as samples were taken from the surface of the waterbody.	**Pass**	Low
Water quality: contaminants	Water column contaminants not to exceed the EQS. (S)	• The sandbanks feature is offshore and does not overlap with any WFD waterbodies. • The adjacent Cardigan Bay Central waterbody was used for the assessment. This waterbody has a fail for chemicals in the 2024 cycle 3 interim classification due to mercury and PBDE. • Confidence is low as there is no direct overlap with the feature; the sandbanks are further offshore; and the human health standard has been used for PBDE.	**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 sandbanks feature in the Cardigan Bay SAC, therefore this target was assessed as unknown.	**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)	• The adjacent Cardigan Bay Central waterbody was classified as Good status for the IQI WFD element in the 2024 cycle 3 interim classification. • Analysis of macrobenthic infaunal communities for the monitored sandbank showed variations across the sampling period but within limits of natural variation. • Confidence is high due to the availability of long term monitoring data and lack of concerning patterns.	**Pass**	High
Species richness and diversity	Maintain the expected richness and diversity of sandbank species, allowing for natural change and variation. (S)	• Analysis of monitoring data has shown an increase of taxa and diversity in recent years. • There was an unexplained decrease of taxa and diversity in 2014 but these recovered in subsequent years. • Confidence is high due to the availability of long term monitoring data and lack of concerning patterns in the most recent years.	**Pass**	High
Taxonomic spread of species	Maintain the expected taxonomic spread of sandbank species, allowing for natural change and variation. (S)	• Overall, the average distinctness of infaunal community of the monitored sandbank remained stable and was within the expected values over the monitoring period. • 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 are currently impacting the condition of sandbanks in the SAC. • Confidence is medium as whilst there have been no new records of NNS in the last six years, there have been no targeted surveys of NNS and the spread and impacts of any INNS present within the feature are not well understood.	**Pass**	Medium
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• There were no new NNS records across the monitored sandbank within the last six years. • Confidence is medium because there have been no targeted surveys of NNS on sandbanks.	**Pass**	Medium

Assessment conclusions

The sandbanks feature in Cardigan Bay SAC has been assessed as being in **favourable** condition (medium confidence). Overall, the lack of any significant anthropogenic impact on this feature in terms of extent, hydrodynamic processes, topography, sediment composition and its associated community, have contributed to this favourable assessment outcome. There was a failure for one secondary target (Table 7) and there were limited or absent data for one key indicator to inform on the condition of the feature (see evidence gaps section 4). This reduced the confidence in the assessment.

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 sandbanks in Cardigan Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Cardigan Bay	**Favourable (medium confidence)**	Water quality: contaminants (S)	• Levels of mercury and PBDE in the Cardigan Bay Central waterbody are failing to meet their relevant EQSs.	• INNS • Water quality: contaminants • Climate change

Detailed assessment information

The unnamed sandbank, which is part of the sandbanks feature in the Cardigan Bay SAC, has been monitored in 2001, 2017 and 2021 using grab sampling surveys.

Extent and distribution

The indicators for extent and distribution of the sandbanks feature in Cardigan Bay SAC pass their targets as there are currently no known anthropogenic impacts that would significantly affect the sandbanks feature. However, there is a lower confidence in the accuracy of the delineation of these mapped features. During the mapping exercise, the feature was generalised (corners rounded). Along with a lack of available repeat data, these issues mean that it is not currently possible to compare extents over time in order to calculate change in extent. 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

The sediment composition varied over the monitoring period with mixed sediments. The macrofaunal abundance was positively correlated to the sediment composition for both sandbanks, indicating that communities are to some extent determined by sediment characteristics. There are no evidence of anthropogenic impacts that would significantly affect the sediment of these sandbanks. Scallop dredging occurs in the bay and while this activity could be modifying sediment composition, this is unlikely as the fishing vessels are not operating on sandbanks. For this reason, the changes seen in sediment composition were assessed to be natural and the sediment composition and distribution indicator therefore met its target. Confidence in the pass is high due to the availability of long term monitoring data and lack of concerning patterns or changes in sediment composition.

The topography and hydrodynamic and sediment transport processes are not well researched for sandbanks. These indicator targets were 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 Cardigan Bay SAC.

Water quality

None of the WFD waterbodies intersect with the sandbanks feature within the SAC. The adjacent Cardigan Bay Central waterbody has been used for the water quality assessment, therefore it may not be a good reflection of the overall effect of water quality on feature, this was considered in the confidence of the water quality assessment. As the sandbanks within the SAC are located further offshore, they are less likely to be impacted by water quality issues derived from the land.

Nutrients (DIN only) and phytoplankton

The targets were met for the nutrients (DIN only) and phytoplankton indicators as the adjacent Cardigan Bay Central waterbody was classified with a High status for both the DIN and the phytoplankton elements in the 2024 cycle 3 interim classification. The confidences were reduced to medium as there was no direct overlap between the

Cardigan Bay Central waterbody and the sandbanks feature. In addition, the ecological relationships between phytoplankton and the sandbanks feature are not well understood.

Dissolved oxygen

The dissolved oxygen indicator met its target as the adjacent Cardigan Bay Central waterbody was classified with a High status for the dissolved oxygen element in the 2024 cycle 3 interim classification. Confidence in the pass was reduced to medium because surface sampling of dissolved oxygen may not detect issues for more demersal features (see further detail in section 3.1).

Contaminants

The Cardigan Bay Central waterbody has a fail for chemicals in the 2024 cycle 3 interim classification, where mercury and PBDE failed. This caused the contaminants indicator to fail. The EQS for mercury is based on the secondary poisoning protection goal (for wildlife). The human health protection goal that is used for PBDE may be considered as over precautionary as the effect of contaminants on the biota of sandbanks are not fully understood. Low confidence was attributed to the fail to reflect this. The waterbody used in the assessment does not overlap with the sandbanks feature and the sandbanks are further offshore and less likely to be impacted by water quality issues derived from the land. 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. The physicochemical indicator could not be assessed due to a lack of data.

Species and communities

The adjacent Cardigan Bay Central waterbody was classified as Good status for the IQI element in the 2024 cycle 3 interim classification.

The sandbank complex in Cardigan Bay SAC is diverse. All species indicators met their targets based on the infaunal analysis. Natural variations in community composition were observed. There was an increase of taxa richness and diversity over time with an unexplained decline in taxa and diversity in 2014. This was not deemed to be a concern since these recovered quickly thereafter. The average taxonomic distinctness of infaunal community remained stable and within the expected values with high number of taxa but comparatively low number of phyla. A high confidence was attributed to the pass for all species indicators due to the availability of long term monitoring data and lack of concerning patterns in recent years.

Invasive non-native species

G. gracilis, a low impact species, was first recorded within the sampling stations in the monitored sandbank in the Cardigan Bay SAC in 2001, and has since declined to its

lowest recorded abundance in 2021. No new NNS were found within the last six years in the sandbanks feature, resulting in the NNS indicator to meet its tertiary target. Confidence in the pass was reduced to medium as there have been no targeted surveys of NNS on sandbanks.

It is not fully understood how this 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 any INNS present the primary target of the INNS indicator passed. Confidence was reduced to medium as whilst there have been no new records of NNS in the last six years, there have been no targeted surveys of NNS, and the spread and impacts of any INNS present within the feature are not well understood.

Reasons for target failure

The sandbanks feature in Cardigan Bay SAC has been assessed as being in **favourable** condition. However, one secondary target failed to be met and needs to be kept under review.

Water quality: contaminants

This indicator target has a secondary weighting. The Cardigan Bay Central waterbody failed 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).

The contaminants in the water column may be derived from diffuse sources from contaminated waterbody bed sediments; or point sources from continuous sewage discharge from wastewater treatment. However, a WFD investigation of the failure in the Cardigan Bay Central waterbody 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 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 Cardigan Bay SAC are stated below.

Invasive non-native species

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

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 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):

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

3.4. Pembrokeshire Marine SAC

The sandbanks feature in Pembrokeshire Marine SAC comprises a number of sandbanks (Figure 6). The NRW Habitats Regulations monitoring has focussed on three named sandbanks within the SAC: Bais Bank South, Turbot Bank and the Knoll. These sandbanks have been assessed together against the performance indicators and an overall condition was assigned for the feature.

Figure 6. Map of the sandbanks feature in Pembrokeshire Marine SAC.
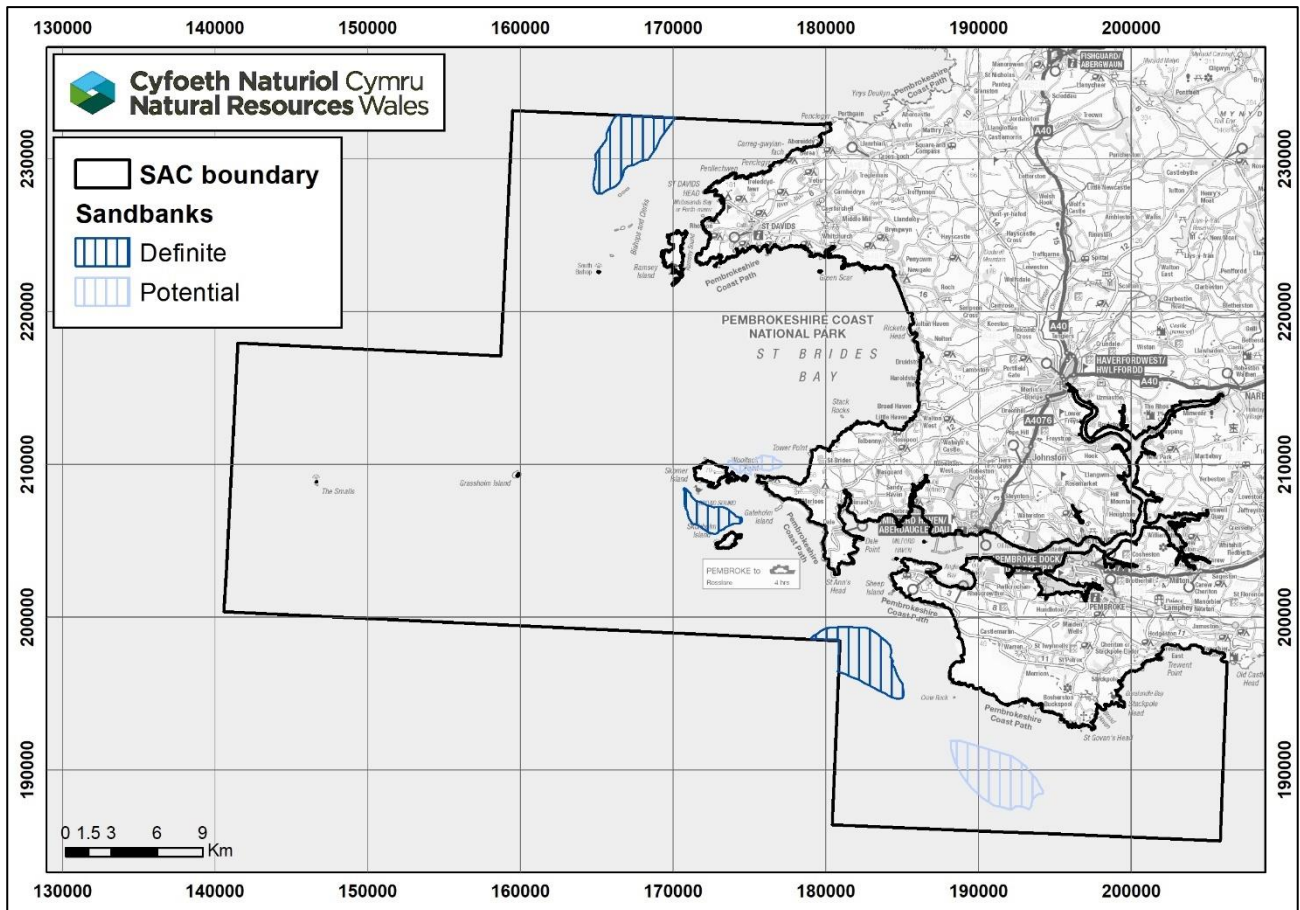
The summary of the assessment outcome is provided in Table 8. These outcomes and reasons of failure are discussed in more detail in the sections below.

Table 8. Condition assessment of sandbanks in Pembrokeshire Marine 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 Pembrokeshire Marine 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 Pembrokeshire Marine 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 for the monitored sandbanks showed some changes in sediment composition but this is likely to be natural. • Confidence is medium due to concerns around an ongoing trend in reducing coarse material and increasing fine material at the Knoll.	**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 observed (~1 m) between 1980 and 2020 for Bais Bank. • There are currently no anthropogenic impacts known to be significantly affecting the topography of Turbot Bank. • Confidence is medium because there was no evidence available for the other sandbanks in the SAC.	**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)	• Modelled data indicated that hydrodynamic and sediment transport processes are functioning as expected for Turbot Bank. • There is no evidence available for the other sandbanks in the SAC. • Confidence is medium because the assessment has been inferred from a model.	**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)	• Both of the WFD waterbodies that overlap with the sandbanks feature have been classified with High status for DIN in the 2024 cycle 3 interim classification (Pembrokeshire South and Cardigan Bay South). Combined, these waterbodies overlap with 26% of the feature. o The Pembrokeshire South waterbody classification was rolled forward from the 2018 cycle 2 interim classification. • Confidence is medium due to the rolled forward classification, and as the waterbodies have a low degree of overlap with 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 two WFD waterbodies was not classified for the phytoplankton WFD element in the 2024 cycle 3 interim classification (Cardigan Bay South). This waterbody overlaps with 7% of the feature. • The other WFD waterbody was classified with a High status for phytoplankton (Pembrokeshire South). This waterbody overlaps with 19% of the feature. • Confidence is medium due to the unclassified waterbody, as the waterbodies have a low degree of overlap with the feature, and because 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)	• Both overlapping WFD waterbodies were classified with High status for dissolved oxygen in the 2024 cycle 3 interim classification (Pembrokeshire South and Cardigan Bay South). Combined, these overlap with 26% of the feature. • Confidence is medium due to samples being taken from surface of the waterbodies, and as the waterbodies have a low degree of overlap with the feature.	**Pass**	Medium
Water quality: contaminants	Water column contaminants not to exceed the EQS. (S)	• Both overlapping WFD waterbodies were not classified as the chemicals have not been assessed within the last six years (Pembrokeshire South and Cardigan Bay South). Combined, these overlap with 26% of the feature. • This indicator was therefore assessed as unknown.	**Unknown**	N/A

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 sandbanks feature in the Pembrokeshire Marine SAC, therefore this target was assessed as unknown.	**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)	• Both overlapping WFD waterbodies were classified as Good status for the IQI WFD element in the 2024 cycle 3 interim classification (Pembrokeshire South and Cardigan Bay South). Combined, these waterbodies overlap with 26% of the feature. • Analysis of macrobenthic infaunal communities for the three monitored sandbanks showed variations across the sampling period. The shift of community composition was smaller in recent years. • Overall, there were no concerns as such variations in community composition are to be expected with ridge sandbanks like Turbot Bank. • Confidence is high due to the availability of long term monitoring data and lack of concerning patterns.	**Pass**	High

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 monitoring data has shown that taxa richness and diversity for the Knoll was not a concern (but not sampled in 2001). • Diversity at Turbot Bank indicated a decline between 2001 and 2013 to rise again subsequently. • There was a decline in diversity for Bais Bank South until 2019 with a slight increase in 2022. • There was a steep decline in taxa richness for Turbot Bank and Bais Bank South after 2001 with better recovery for Turbot Bank. • Confidence in the fail is low due to concern only for a few sampling stations for Bais Bank South and uncertainty around the cause of this decline.	**Fail**	Low
Taxonomic spread of species	Maintain the expected taxonomic spread of sandbank species, allowing for natural change and variation. (S)	• Overall, the average distinctness of infaunal community of the three monitored sandbanks was within the expected values over the monitoring period. • 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 are no records of INNS on any of the three monitored sandbanks. • Confidence is medium because there have been no targeted surveys of NNS.	**Pass**	Medium
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• There were no NNS records across all the three monitored sandbanks. • Confidence is medium because there have been no targeted surveys of NNS on sandbanks.	**Pass**	Medium

Assessment conclusions

The sandbanks feature in Pembrokeshire Marine SAC has been assessed as being in **favourable** condition (medium confidence). Overall, the lack of any significant anthropogenic impact on this feature in terms of extent, hydrodynamic processes, topography, sediment composition and its associated community, have contributed to this favourable assessment outcome. There was a failure for one secondary target (Table 9) and there were limited or absent data for one key indicator to inform on the condition of the feature (see evidence gaps section 4). This reduced the confidence in the assessment.

A summary of the assessment can be seen in Table 9 with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 9. Summary of the condition assessment for sandbanks in Pembrokeshire Marine SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Pembrokeshire Marine	**Favourable (medium confidence)**	Species richness and diversity (S)	• There was a large decline in species richness since 2001 at some sampling stations within Bais Bank South.	• Cable laying and maintenance • INNS • Water quality: contaminants • Climate change

Detailed assessment information

Bais Bank South, Turbot Bank and the Knoll, which are part of the sandbanks feature in the Pembrokeshire Marine SAC, were monitored in 2001 and every three years between 2008-2022 using grab sampling surveys.

Extent and distribution

The indicators for extent and distribution of the sandbanks feature in Pembrokeshire Marine SAC pass their targets as there are currently no known anthropogenic impacts that would significantly affect the sandbanks feature. While there is a high confidence in the delineation of Turbot Bank since it was mapped using multibeam in 2012, the other sandbanks have moderate confidence for accurate delineation. A lack of repeat data for some of these sandbanks means it is not possible to calculate changes in extent over time for these features. 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

Granulometric analysis indicated some variations in sediment composition especially between 2001 and 2013, fluctuating between 250-500 µm (medium sand) and 500-1000 µm (coarse sand) grain size. This variation was deemed to be natural and could possibly be explained by the topography of a sandbank. Sample stations are in fixed positions but sandwaves move across the bank over time. This means that sometimes samples may be collected from the peak of a sandwave and sometimes from the trough and flanks, which could explain the variation in grain size. Different particle size distribution analysis methods were used during the monitoring period with dry sieving techniques used in 2001 and from 2008 to 2012, while laser diffraction was used from 2013 onwards. Sieve and laser diffraction methods measure particle size differently. Sieving measures a particle using the two shortest dimensions, while laser diffraction measures the particle equivalent to a sphere of the volume measured. For the same particle (unless perfectly round), the sieve weight will be smaller than the laser derived weight. This difference in analysis may have contributed to the variation observed, especially between 2001 and 2013. There was also an ongoing trend in reducing coarse material and increasing fine material at the Knoll. These changes were not deemed to be large enough to fail the sediment composition and distribution indicator target, but did reduce confidence in the pass to medium, and will be something to pay close attention to in the next assessment.

Bathymetry analysis of Bais Bank indicated relatively small changes in topography, with average accretion of 1.3 m (standard deviation 0.6 m) between 1980 and 2020; there was some indication of strong accretion on the northwest flank, possibly related to slight migration of the bank position. There are currently no known anthropogenic impacts that significantly affect Turbot Bank, as suggested by the modelled data issued by contractors. This evidence has resulted in a pass for the topography of the feature target, with a medium confidence score due to variation in data collection, processing methods among years, and the lack of data for the other monitored sandbank (the Knoll).

Hydrodynamic and sediment transport processes are not well researched for sandbanks. Some modelled data issued by contractors in Turbot Bank indicated that natural processes

were occurring in this sandbank, and that there are currently no known anthropogenic activities that are known to have a significant impact on the Turbot Bank. For this reason, the hydrodynamic and sediment transport processes indicator met its target, but confidence was reduced to medium due to the lack of evidence for other sandbanks and the inferred nature of a model outcome.

Water quality

It has been estimated that approximately 26% of the sandbanks feature within the SAC falls within two WFD waterbodies, therefore it may not be a good reflection of the overall effect of water quality on feature, this has impacted the confidence of the water quality assessments. These waterbodies are Pembrokeshire South, which overlaps with 19% of the feature, and Cardigan Bay South, which overlaps with 7%.

Nutrients (DIN only) and phytoplankton

The nutrients (DIN only) indicator met its target as both of the WFD waterbodies that overlap with the sandbanks feature were classified with a High status for the DIN element in the 2024 cycle 3 interim classification. However, the classification for the Pembrokeshire South waterbody was rolled forward from the 2018 cycle 2 interim classification. The confidence was reduced to medium to reflect this, and due to the low degree of overlap between the sandbanks feature and the waterbodies within the SAC.

The phytoplankton also met its target as one of the two WFD waterbodies was classified with a High status for phytoplankton in the 2024 cycle 3 interim classification. This was the Pembrokeshire South waterbody, which overlaps with 19% of the feature. The other overlapping WFD waterbody was not classified for this 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). Confidence was reduced to medium due to the low degree of overlap between the sandbanks feature and the waterbodies within the SAC. In addition, the ecological relationships between phytoplankton and sandbanks are not well understood.

Dissolved oxygen

The dissolved oxygen indicator met its target. Confidence in the pass was reduced to medium because surface sampling of dissolved oxygen may not detect issues for more demersal features (see further detail in section 3.1).

Contaminants

Both of the two WFD waterbodies that overlap with the sandbanks feature were not classified as the chemicals have not been assessed within the last six years. This indicator was therefore assessed as unknown.

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. The physicochemical indicator could not be assessed due to a lack of data.

Species and communities

Both WFD waterbodies that overlap with the sandbanks feature were classified as Good status for the IQI element in the 2024 cycle 3 interim classification (Pembrokeshire South and Cardigan Bay South). Combined, these waterbodies overlap with 26% of the sandbanks feature.

Infaunal analysis showed that the species comprising the communities present in the three monitored sandbanks varied across the sampling period with many fluctuations. Such variations in community composition are to be expected with ridge sandbanks such as Bais Bank. Depending on where the grab sampling took place, communities could be sampled from a trough, flank or a mobile peak and these tend to move with time, further increasing variations in community composition. The low number of taxa can also accentuate any changes observed in community analysis. Overall, there was no concern with the abundance, distribution and species composition of communities indicator, resulting in a pass with high confidence.

Bais Bank South failed to meet the indicator target for species richness and diversity, resulting in an overall failure for this indicator. Analysis revealed a steep decline in taxa richness since 2001 for Turbot Bank and Bais Bank. Some form of recovery was apparent for Turbot Bank while taxa richness for Bais Bank South had not yet recovered (Figure 7). The decline of taxa richness was observed only at a few stations for Bais Bank South and a further decline in abundance at two stations over time suggested some disturbance. There are no known anthropogenic activities that could significantly impact Bais Bank South. While possible fishing activities could impact sandbanks, the bathymetry and distance from the shore of Bais Bank is not particularly favourable to this type of activity and there is no evidence of impact. There is, therefore, some uncertainty on the causes of these declines seen at only a few stations resulting in a low confidence assessment. There was no concern for the Knoll for taxa richness and diversity, but sampling started after 2001 so a possible decline in taxa observed in the other two sandbanks may be possible but not observed within this timeframe.

The average distinctness of the infaunal community of the three 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 and lack of concerning patterns.

Figure 7. Diversity indices of macrofauna sampled at Bais Bank South sandbank across the monitoring survey period 2013, 2016, 2019 and 2022 (Van Veen grab 0.1 m^2). a) taxa richness, b) Shannon-wiener diversity (log$_e$), c) abundance (replicates averaged) and d) Pielou's evenness. Teleost and lancelet are excluded for all indices, sessile epifauna are included in Taxa Richness only.
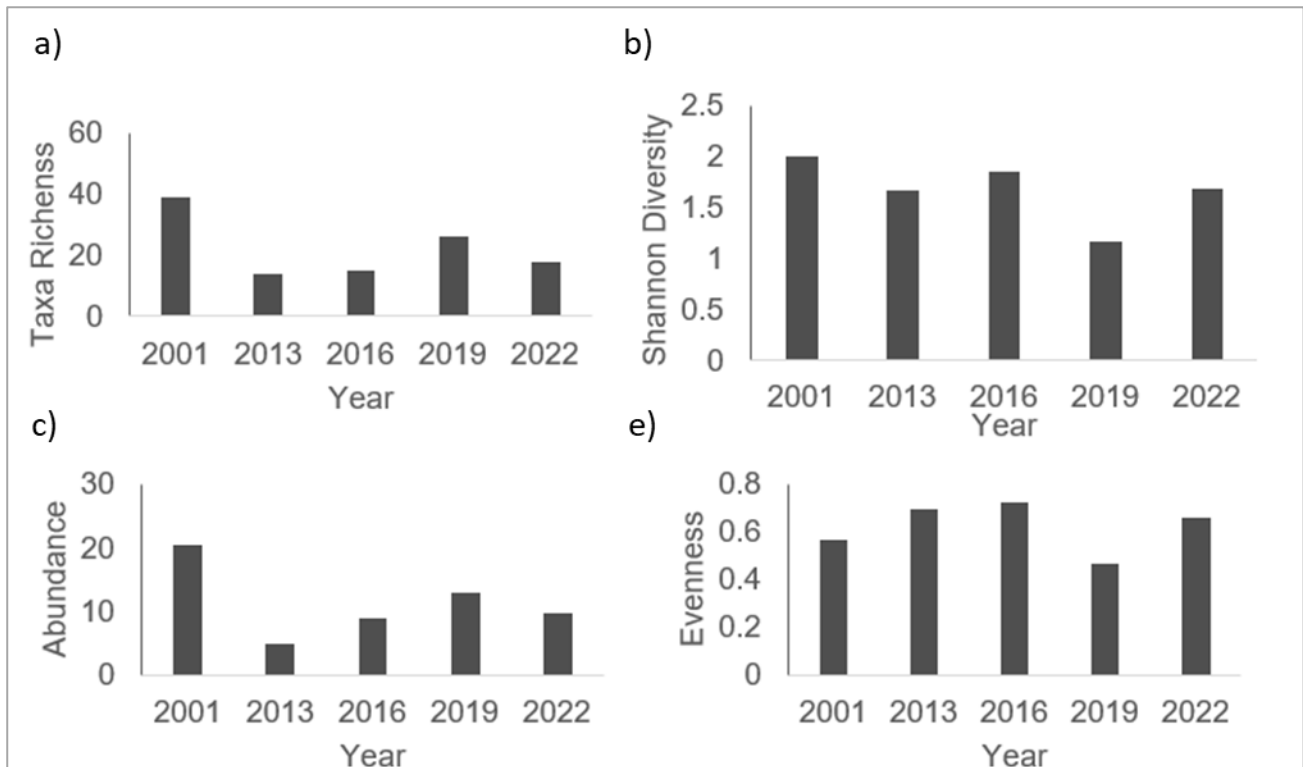
Invasive non-native species

There has historically been a high number of NNS in other parts of the SAC, especially within the Milford Haven Waterway, but also close to Skomer island. However, there were no NNS found within the three monitored sandbanks, resulting in INNS and NNS indicators to meet both its primary and tertiary targets. Confidence in the pass was reduced to medium as there have been no targeted NNS surveys on sandbanks, which would be required to fully understand the presence and future impacts of any INNS species within the sandbanks feature.

Reasons for target failure

The sandbanks feature Pembrokeshire Marine SAC has been assessed as being in **favourable** condition. However, one secondary target failed to be met and needs to be kept under review.

Species richness and diversity

This indicator target has a secondary weighting. This indicator failed as there has been a large decline of taxa richness since 2001 at some stations in Bais Bank South with little recovery. From the evidence it is not clear what is causing this decline and further investigation will be needed to understand the reason for this failure and allow management measures to be implemented.

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 Pembrokeshire Marine SAC are stated below.

Invasive non-native species

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

There have been confirmed records of *C. fornicata* within the Pembrokeshire Marine SAC. There are currently no recorded observations of the species on the sandbanks feature. Most records are within the Milford Haven Waterway. There have been three recorded observations of the species near to the Martin's Haven and Middleholm Bank (2011, 2013 and 2016). At high densities, this species could cause an impact on the feature (see further detail in section 3.1).

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 SAC 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.

3.5. Carmarthen Bay and Estuaries SAC

The sandbanks feature in Carmarthen Bay and Estuaries SAC consists of a single sandbank, Helwick Bank (Figure 8). This sandbank has been assessed against the performance indicators and an overall condition was assigned for the feature.

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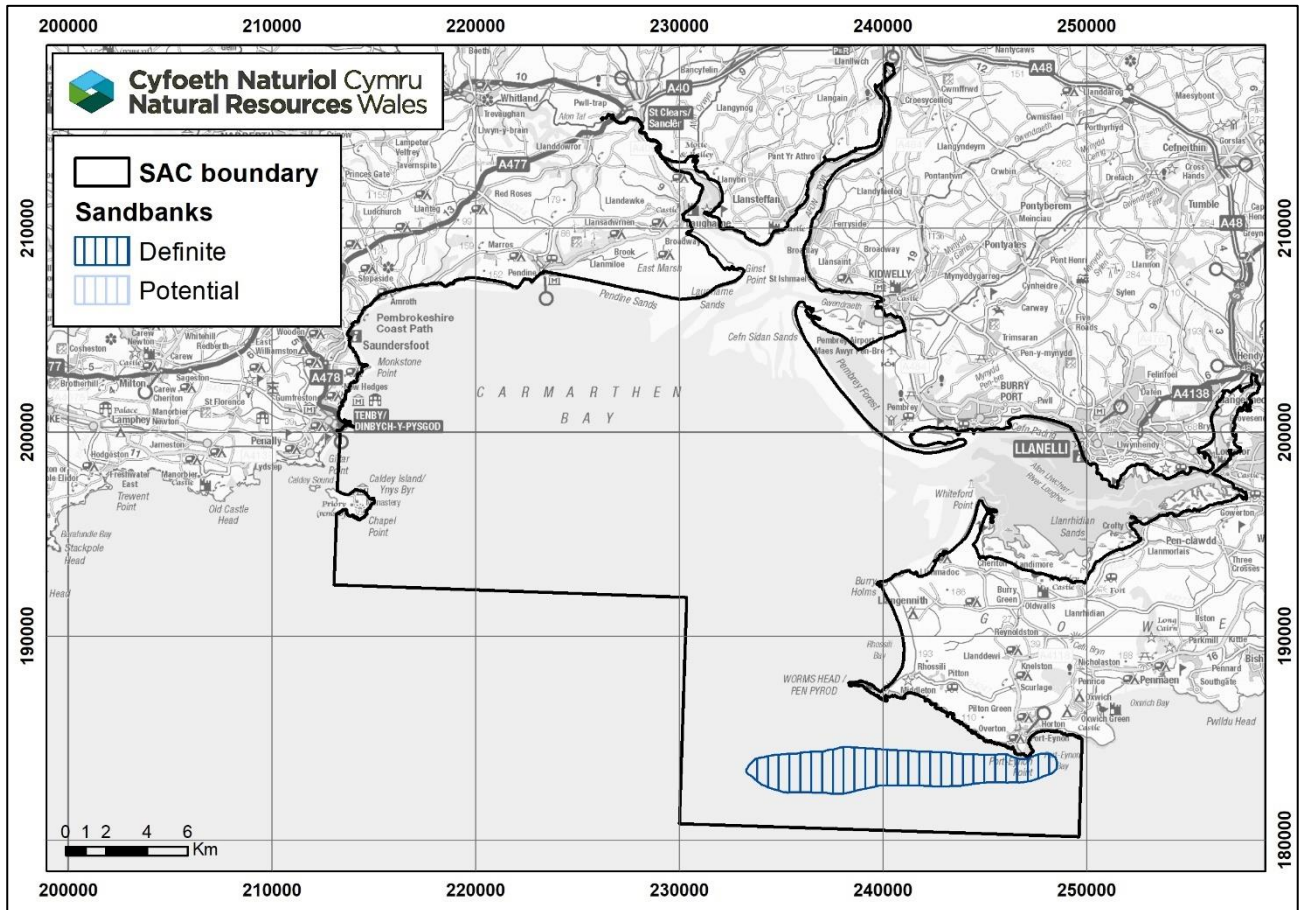
The summary of the assessment outcome is provided in Table 10. These outcomes and reasons of failure are discussed in more detail in the sections below.

Table 10. Condition assessment of sandbanks in Carmarthen Bay and Estuaries 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 sandbank 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 Carmarthen Bay and Estuaries SAC. • Confidence is medium as the assessment has not been based on comparison mapping of the feature and expert judgment was used.	**Pass**	Medium
Sediment composition and distribution	Maintain composition of sediment granulometry across the sandbank, allowing for natural change and variation. (P)	• Granulometric analysis for the monitored sandbank showed some changes in sediment composition but this is likely to be natural. • There are currently no known anthropogenic impacts on the sediment composition. • Confidence is medium due to the presence of the unusual clumps of clay during the 2022 monitoring survey.	**Pass**	Medium
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of the sandbanks. (P)	• Scientific evidence suggested that the bank volume may be naturally reducing. • Confidence is medium because the evidence used was from a relatively old report, and there are no recent survey data.	**Pass**	Medium
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity, allowing for natural variation and change. (P)	• Modelled data indicated that hydrodynamic and sediment transport processes are functioning as expected. • Confidence is medium as the available data are inferred from models.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
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)	• The one WFD waterbody that overlaps with the sandbanks feature has been classified as Good status for DIN in the 2024 cycle 3 interim classification (Carmarthen Bay). This waterbody overlaps with 76% of the sandbanks feature and has improved from Moderate status in previous cycles. • Confidence is high as there were no WFD waterbodies that overlap with the feature that were not classified or failed for the DIN element.	**Pass**	High
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)	• The Carmarthen Bay waterbody was classified with a Good status for the phytoplankton WFD element in the 2024 cycle 3 interim classification. This waterbody has improved from Moderate status in the 2021 cycle 3 classification. • Confidence is low as the sampling locations for phytoplankton were not close to the sandbanks feature, due to the previous phytoplankton failure in the Carmarthen Bay waterbody in the 2021 cycle 3 classification, and because the ecological relationships between phytoplankton and the sandbanks feature are not well understood.	**Pass**	Low

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. (S)	• The Carmarthen Bay waterbody that overlaps with the sandbanks feature was classified as 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.	**Pass**	Medium
Water quality: contaminants	Water column contaminants not to exceed the EQS. (S)	• The Carmarthen Bay waterbody has a fail for chemicals in the WFD interim Cycle 3 assessment, due to mercury, PBDE and cypermethrin. • Confidence is reduced as the human health standard has been used for PBDE.	**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 Carmarthen Bay and Estuaries SAC, therefore this target was assessed as unknown.	**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)	• The overlapping WFD waterbody was classified as Good status for the IQI WFD element in the 2024 cycle 3 interim classification (Carmarthen Bay). This waterbody overlaps with 76% of the sandbanks feature. • Analysis of macrobenthic infaunal communities for Helwick bank indicated variation across monitoring period, which were consistent across stations. • Confidence is medium as there was a degree of change seen in infaunal communities but reasons are unknown.	**Pass**	Medium
Species richness and diversity	Maintain the expected richness and diversity of sandbank species, allowing for natural change and variation. (S)	• There was an increase of taxa richness since 2013. • There was a sudden drop in diversity in 2016 possibly caused by an unexpected large mussel settlement which is likely to be natural • Confidence is high due to the availability of long term monitoring data and lack of concerning patterns.	**Pass**	High
Taxonomic spread of species	Maintain the expected taxonomic spread of sandbank species, allowing for natural change and variation. (S)	• The average of taxonomic distinctness improved over time, but the years were all below the level of expectation. • Confidence is medium because all sampling years were below the expected level.	**Pass**	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. *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 surveys on NNS.	**Pass**	Low
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• *C. fornicata* was recorded for the first time in 2019 and has now increased from one individual to seven in 2022 on the sandbank. • 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 Carmarthen Bay and Estuaries SAC has been assessed as being in **favourable** condition (medium confidence). Overall, the lack of any significant anthropogenic impact on this feature in terms of extent, hydrodynamic processes, topography, sediment composition and its associated community, have contributed to this favourable assessment outcome. There was a failure for one secondary and one tertiary target (Table 11) and there were limited or absent data for one key indicator to inform on the condition of the feature (see evidence gaps section 4). This reduced the confidence in the assessment.

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 Carmarthen Bay and Estuaries SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Carmarthen Bay and Estuaries	**Favourable (medium confidence)**	Water quality: contaminants (S) Non-Native Species (T)	• Levels of mercury, PBDE and cypermethrin in the Carmarthen Bay waterbody are failing to meet their relevant EQSs. • There has been an increase in the number of *C. fornicata* in the SAC.	• INNS • Water quality: contaminants • Climate change

Detailed assessment information

Helwick Bank, which is part of the sandbanks feature in the Carmarthen Bay and Estuaries SAC, has been monitored in 2001 and every three years between 2013-2022 using grab sampling surveys.

Extent and distribution

The indicator for extent of the sandbanks feature in Carmarthen Bay and Estuaries SAC met its target as there are currently no known anthropogenic impacts that would significantly affect the feature. The current mapped extent of sandbank is not highly accurate as the sandbank was mapped in the past with a generalised shape, but bathymetry data indicates that it is more complex. Differences in the data collection methods makes comparison difficult. There was also no recent bathymetry for Helwick Bank. These factors have reduced the confidence in the target assessment to medium. More resources are needed to accurately and regularly map sandbanks using bathymetry techniques. The distribution of the feature target is not applicable to this SAC as there is only one sandbank in the Carmarthen Bay and Estuaries SAC.

Sediment, topography and hydrodynamics

Sediment composition varied across stations and over the monitoring period, but no trend was detected. Sediment composition was positively correlated to the abundance of infauna, indicating that communities are to some extent determined by sediment characteristics. An ad-hoc mussel dredging operation was conducted in 2015 but no changes in sediment composition were observed. There were some unusual observations of clay clumps among clean fine and medium sand during the 2022 monitoring survey. This were not captured in the samples for the sediment composition analysis. Such clay clumps could be an indication of disturbance since they could be deposited from anthropogenic activity. It is unlikely these clumps of clay were a relic of dredging activities since they were relatively limited on a small area of the bank and the dredging stopped in 2005. The clumps could originate from possible erosion of boulder clay nearby further transported as bedload, but no previous records have shown this process to occur. These clay clumps will be something to pay close attention to in the next assessment. Variation in sediment composition was judged to be natural based on the granulometric analysis. Therefore the sediment composition and distribution indicator target was met. However, the presence of the unusual clumps of clay has reduced the confidence in the pass to medium.

Helwick Bank has been historically dredged but after a public enquiry (2005), the permitted extraction rate and time period was significantly reduced from that proposed. The new licence was not used and was eventually relinquished by the applicant. Scientific research found that the reduction in volume through time was greater than reduction from dredging (Lewis et al., 2015). Since there are currently no known anthropogenic activities that could significantly impact the sandbanks feature, the topography of sandbank indicator has been judged to pass the target. The confidence in the target assessment was reduced to medium due to the lack of recent surveys.

Models also indicated that the hydrodynamic and sediment transport processes were typical of a sandbank with no concern, resulting in a pass for the hydrodynamic and

sediment transport processes indicator. A medium confidence was attributed to the pass due to the inferred nature of the output model.

Water quality

It has been estimated that approximately 76% of the sandbanks feature within the SAC falls within one WFD waterbody (Carmarthen Bay), therefore this is likely to be a good reflection of the overall effect of water quality on the feature.

Nutrients (DIN only) and phytoplankton

The nutrients (DIN only) and phytoplankton indicators met the targets. A high confidence was attributed to the pass for the nutrients indicator as the one WFD waterbody that overlaps with the feature was classified with a Good status for DIN in the 2024 cycle 3 interim classification.

The Carmarthen Bay waterbody was classified with a Good status for the phytoplankton element in the 2024 cycle 3 interim classification, however it was Moderate status in the 2021 cycle 3 classification. The failure in this waterbody was uncertain in 2021 as the EQR was close to the Good status boundary (Lock, 2021). The confidence in the pass for the phytoplankton indicator was reduced to low to reflect this recent failure, and because the sampling locations for phytoplankton were not close to the sandbanks feature. In addition ecological relationships between phytoplankton and the sandbanks feature are not well understood.

Dissolved oxygen

The dissolved oxygen indicator met its target. Confidence in the pass was reduced to medium because surface sampling of dissolved oxygen may not detect issues for more demersal features (see further detail in section 3.1).

Contaminants

The Carmarthen Bay waterbody has a fail for chemicals in the 2024 cycle 3 interim classification, where mercury, PBDE and cypermethrin failed, causing the contaminants indicator to fail. The EQS for cypermethrin is very low, and in the previous lab methodology it was not possible to detect concentrations below the EQS. There has been a waterbody status change (pass to fail) between the 2021 cycle 3 classification and 2024 cycle 3 interim classification due to this reason. Cypermethrin is a synthetic pyrethroid insecticide and is highly toxic to some aquatic species (EA, 2019), but now has a restricted use in Wales. Mercury has failed in the waterbody since the 2015 cycle 2 classification. The EQS for mercury is based on the secondary poisoning protection goal (for wildlife). The PBDE failure was 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. This has reduced the confidence in the fail to medium. 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. The physicochemical indicator could not be assessed due to a lack of data.

Species and communities

The Carmarthen Bay waterbody was classified as Good status for the IQI element in the 2024 cycle 3 interim classification. This waterbody overlaps with 76% of the sandbanks feature.

Infaunal analysis showed that the species comprising the communities present in Helwick Bank vary widely across the monitoring period, but these variations were consistent across stations. There was some degree of change especially after 2001 and some form of recovery but the cause of this is unexplained and was not deemed large enough to fail the abundance, distribution and species composition of communities indicator. The confidence in the assessment, however, was reduced to medium.

There was a minor decrease of taxa richness after 2001, with a significant drop in 2016. This was possibly due to the unusual high abundance of mussel *Mytilidae* (inc. juvenile) in that year. Diversity increased again in 2019 and 2021 to levels similar to those observed in 2001 and 2013. The taxa richness has increased over the monitoring period. The species richness and diversity indicator therefore met its target with a high confidence as there have been no concerning declines in richness or diversity over the whole monitoring period.

The taxonomic distinctiveness analysis showed that the recent years were high in terms of number of species with a relatively high average distinctiveness. This indicates an improvement over time and resulted in a pass for this target. However, all sampling years were below the expected level, which may be explained by the sediment composition of Helwick Bank (e.g. mostly sandy), compared to more varied sandbanks that would have cause an increase of species, boosting the baseline level. For this reason, the assessment confidence has been reduced to medium.

Invasive non-native species

C. fornicata was recorded for the first time in 2019 and has now increased from one large individual in 2019 to seven small individuals in 2022. The specimens recorded were found at two stations around the base of the sandbanks feature which have similar sediment types (e.g. mixed). The presence of this species in the sandbanks feature has resulted in a fail for the tertiary target of the NNS indicator. Confidence is high as this is a new NNS recorded in the feature within the last six years.

It is not fully understood how this species may spread and 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 sandbanks feature in Carmarthen Bay and Estuaries 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. A large proportion of the sandbanks feature in the SAC overlaps with one WFD waterbody, Carmarthen Bay, that failed for chemicals. This waterbody failed due to mercury, PBDE 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). 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 from atmospheric deposition and contaminated waterbody bed sediments, or point sources from continuous sewage discharge from wastewater treatment. However, a WFD investigation of the failure in the waterbody 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.

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 records of *C. fornicata* found in the sandbanks feature within the last six years. The full extent of the impact that this 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

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 Carmarthen Bay and Estuaries 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 pose a risk to its condition.

The abundance of *C. fornicata*, at two stations on the sandbanks feature has increased from 2019 to 2022. At high densities, this species could cause an impact on the feature (see further detail in section 3.1).

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 SAC 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.

4. Evidence gaps for the sandbanks feature

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

Listed below 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. Not all evidence gaps apply to every SAC, see Table 12 for details.

Table 12. Evidence gaps for the sandbanks feature in Welsh SACs. 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.
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 or medium confidence (limited data)	• The spread and impact of NNS currently present at all SACs 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.

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 in any of the SACs. • 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)	Not assessed / unknown	• There were no temperature, salinity or pH loggers within the Cardigan Bay, Pembrokeshire Marine and Carmarthen Bay and Estuaries SACs relevant to the sandbanks feature. • Further evidence on temperature change is required to adequately assess this indicator in the other SACs. Some physicochemical parameters such as salinity and pH have not been assessed in any SACs. 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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