

ASSESSMENT AGAINST THE MCZ SELECTION GUIDELINES

Carlingford Lough Proposed Marine Conservation Zone (pMCZ)

Sea-pen (*Virgularia mirabilis*) © Claire Goodwin



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Summary

The assessment against the Guidance on selection and designation of Marine Conservation Zones (MCZs) in the Northern Ireland Inshore Region is a document produced as part of the consultation evidence base, following the OSPAR design principles. This assessment helps to identify Areas of Search (AoS) and determine features proposed for protection within them. It also highlights where additional locations or features are required or when a different size or shape of boundary is needed to develop the Marine Protected Area (MPA) network.

Following the NI Guidance the process includes five stages from the identification of the AoS (Stage 1) to the development of the MCZ proposals (Stage 5). Only locations which have passed through all the stages of the assessment are considered for formal designation and inclusion in the MPA network.

This document provides details of the assessment of Carlingford Lough pMCZ against the selection criteria.

Additional information on Carlingford Lough pMCZ and proposed features includes:

- Guidance on selection and designation of Marine Conservation Zones (MCZs) in the Northern Ireland Inshore Region
- Justification report for selection of proposed Marine Conservation Zone (pMCZ) features
- Guidance on the development of Conservation Objectives and potential Management Options
- Conservation Objectives and potential Management Options for Carlingford Lough pMCZ
- Data Confidence Assessment for Carlingford Lough pMCZ

History of development

The Carlingford Lough pMCZ is proposed for protection of the pMCZ feature Subtidal (sublittoral) mud containing Sea-pen and white sea-slug or lobe shell communities. The biotope for this habitat feature is [SS.SMu.IFiMu.PhiVir](#) (*Philine aperta* and *Virgularia mirabilis* in soft stable infralittoral mud).

The Sublittoral Survey Northern Ireland (SSNI, Goodwin *et al.*, 2007) and survey work carried out by AFBI (2012) identified exceptionally high densities of Sea-pen and white sea slug communities in the muddy substrata of the Lough over several years. Recent survey work completed by DOE Marine Division (June 2015) included underwater video and still images, infaunal grab samples and Particle Size Analysis (PSA) which validated the Subtidal mud seabed in the AoS (classified as slightly gravelly muddy sand). High densities of Sea-pen and white sea slug were also recorded in the inner part of the Lough within the area proposed as an MCZ.

This data, combined with information on the uses and activities in the area and jurisdictional considerations supported the amendment of the initial proposed boundary. The new boundary was drawn following the extent of the proposed habitat to conserve

its integrity and to represent the range in diversity of Subtidal (sublittoral) mud habitats within the area while taking into account stakeholder feedback and advice. A buffer zone of 100m from aquaculture sites (north to south-east borders) was taken into consideration when developing the pMCZ boundary following pre-consultation discussion with industry representatives. This will enable shellfish operations to continue without impacting the conservation objectives or the integrity and diversity of the site. In addition, administrative mid-line was taken into account for the southern extent of the boundary.

Details on the supporting evidence are provided on the Carlingford Lough pMCZ Data Confidence Assessment.

Glossary of Terms and Acronyms

AoS - Area of Search used to underpin the proposed Marine Conservation Zone

AFBI - Agri-food and Biosciences Institute

Benthic - the ecological region at the lowest level of a body of water such as an ocean or a lake including the sediment surface and some sub-surface layers

Biotope - the region of the habitat associated with a particular ecological community

Conservation objective - A statement of the desired ecological/geological state (quality) of a feature (habitat, species or geological) for which the MCZ is designated

EUNIS - European Nature Information System, is a habitat classification system used throughout Europe and covers all types of natural and artificial habitats, both aquatic and terrestrial

Infaunal - aquatic animals such as clams or burrowing worms that live beneath the surface of a sea or lake floor

Infralittoral - describes the zone from mean low water down to a depth where 1% of light can reach the seabed (JNCC)

MCZ - Marine Conservation Zone used to refer to MCZs designated under section 13 of the Marine Act (Northern Ireland) 2013 in the Northern Ireland inshore region and in section 116 of the Marine and Coastal Access Act 2009 in the Northern Ireland offshore region adjacent to Northern Ireland

MPA - As a generic term Marine Protected Areas are a clearly defined geographical space, recognised, dedicated and managed, through legal or other means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values. As a specific term it refers to a national designation in Scotland (equivalent to MCZ)

OSPAR - OSPAR is the mechanism by which fifteen Governments of the western coasts and catchments of Europe, together with the European Union, cooperate to protect the marine environment of the North-East Atlantic

OSPAR T&D - OSPAR List of Threatened and/or Declining Species and Habitats

pMCZ - Proposed Marine Conservation Zone

pMCZ Feature - proposed Marine Conservation Zone Feature(s) that will underpin the MCZ designation

PSA - Particle Size Analysis

RIA - Regulatory Impact Assessment

SM - Subtidal (sublittoral) mud

SPWS - Sea-pen and white sea slug communities

SSNI - Sublittoral Survey Northern Ireland

VMS - Vessel Monitoring System

Carlingford Lough pMCZ – Application of the MCZ selection guidelines

Stage 1 - Identifying the Area of Search

Summary of assessment	<p>The Carlingford Lough AoS (Figure 1) contains the pMCZ feature Sea-pen (<i>V. mirabilis</i>) and white sea slug (<i>P. aperta</i>) communities. This habitat is the only known example in Northern Ireland and is one of the few records within the UK (a few more records are reported in the South of Ireland) (NBN gateway web and JNCC, 2015).</p> <p>In the UK and Ireland, these communities are restricted to the most sheltered sea Loughs with full salinity conditions. This feature appears to be in good condition within the AoS (Goodwin <i>et al.</i> 2011) and restricted to the small area proposed as an MCZ (Figure 2). The Sea-pen, <i>V. mirabilis</i>, is a Northern Ireland Priority Species and in this area is present in high densities.</p> <p>This habitat occurs on Subtidal (sublittoral) mud; this broad scale habitat is representative of Northern Ireland’s seas more generally.</p>
	Guideline met.

Detailed assessment			
Proposed protected features	Guideline 1a <i>Presence of key features</i>	Guideline 1b <i>Presence of features at threat and/or decline</i>	Guideline 1c <i>Presence of ecological resources/geological processes critical to functioning of the ecosystem</i>
<i>Biodiversity</i>			
Subtidal (sublittoral) mud ¹ (SM): Sea-pen and white slug communities ² (SPWS)	✓	<i>Representative feature</i>	

¹ Broad scale habitat. [EUNIS Habitat type A5.3](#) (level 3) that contains infralittoral fine mud (McBreen & Askew, 2011).

² SM component (subscale) habitat. Biotope - SPWS (*Philine aperta* and *Virgularia mirabilis* in soft stable infralittoral mud) [SS.SMu.IFiMu.PhiVir](#) – [EUNIS A5.343](#).. This biotope is very similar to Sea-pen and burrowing megafauna communities, with the biotope [SS.SMu.CFiMu.SpnMeg](#) (an OSPAR Threatened and/or Declining Species - OSPAR, 2010), but occurs shallower, is less stable, and is not characterised by burrowing megafauna (JNCC, 2014, Hughes, 1998).

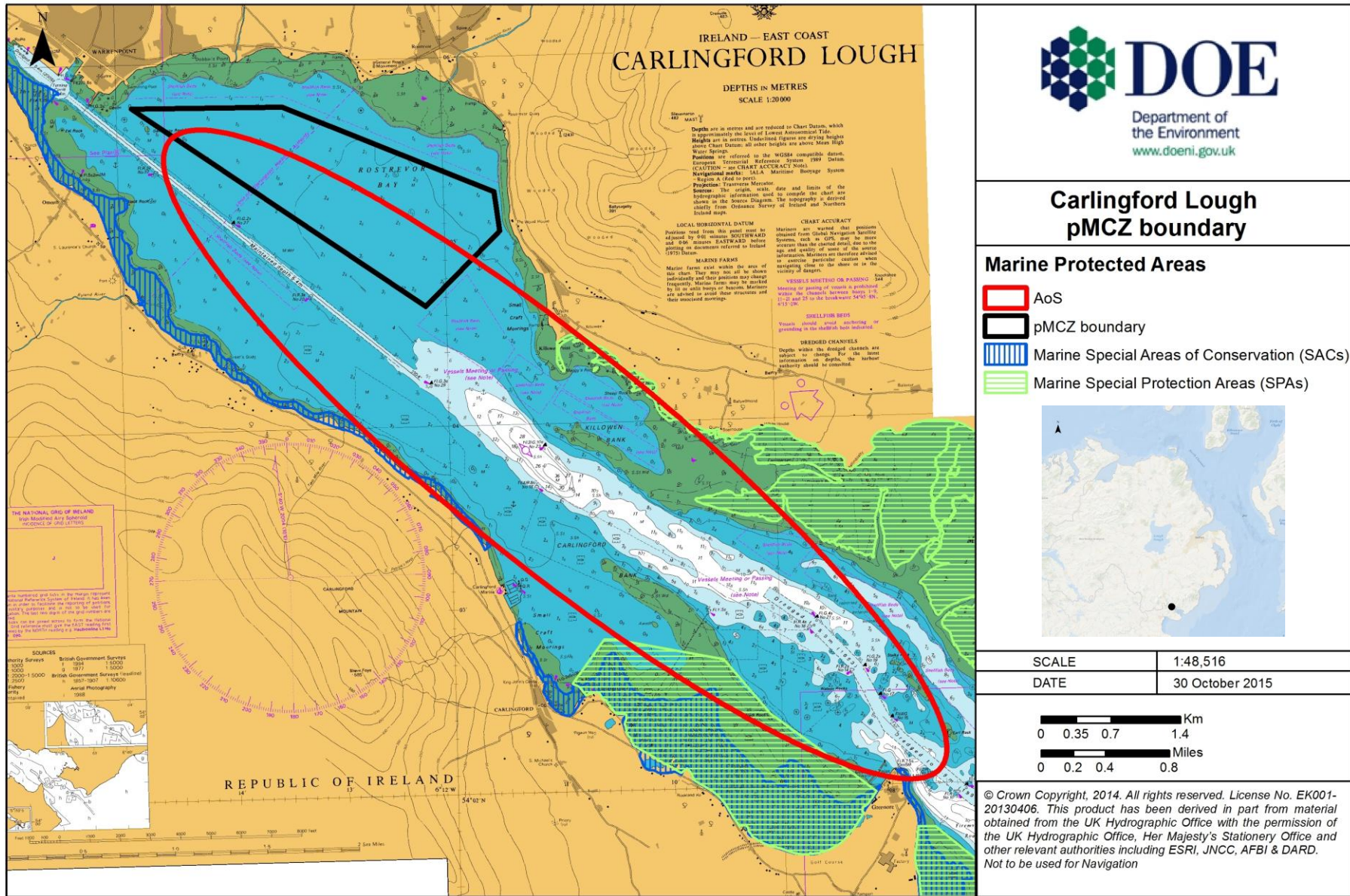


Figure 1 Location of Area of Search and the proposed boundary of Carlingford Lough pMCZ

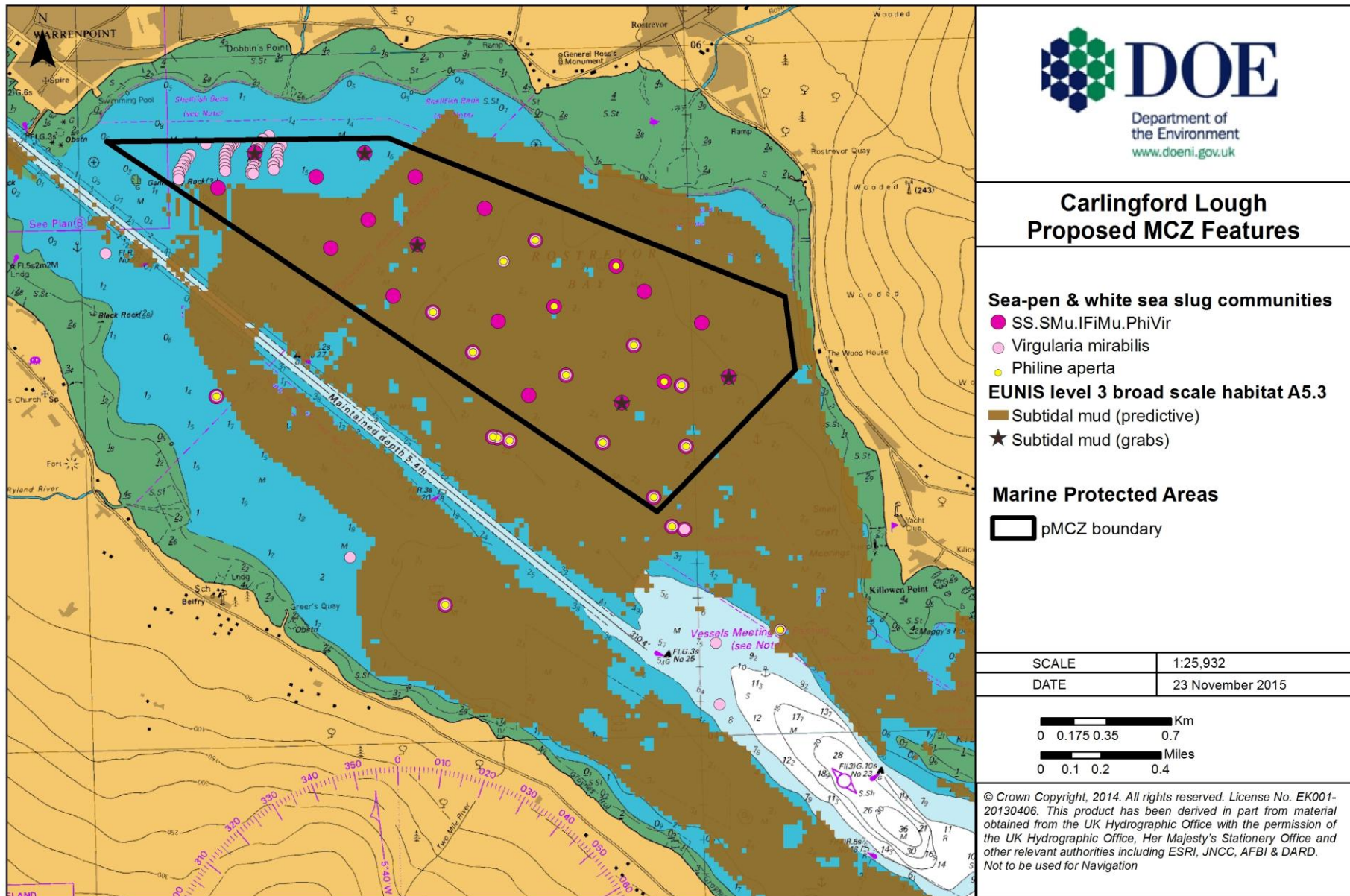


Figure 2 Distribution of the pMCZ features in Carlingford Lough

Stage 2 - Prioritise the Area of Search based on quality of pMCZ features contained

Summary of assessment	<p>Subtidal (sublittoral) mud habitats along with SPWS communities are naturally diverse habitats spatially and functionally linked. This slightly gravelly mud seabed is inhabited by a dense and undisturbed population of small Sea-pen (<i>V. mirabilis</i>) and white sea-slug (<i>P. aperta</i>) that represents the only example of this type in Northern Irish waters and one of few in UK and Irish waters (Hughes, 1998). Carlingford Lough is affected by a range of activities (the Lough has a commercial port and significant shellfish aquaculture takes place throughout); however, the inner area proposed as an MCZ remains undisturbed, with limited human activity thus the pMCZ habitat feature is thought to be in a relatively good condition. The pMCZ habitat is vulnerable to a range of pressures in the area associated with shellfish aquaculture farms, shellfish dredging, navigational dredging, discharges, tourism and recreation, moorings, and anchoring and infrastructure development.</p> <p>The pMCZ feature is considered to be at moderate risk of future significant damage should the intensity of activities increase or if there are new developments in the area.</p> <p>Five of the six Stage 2 Guidelines have been met (2a-2e).</p>
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Detailed assessment

Guideline 2a The Area of Search contains a combination of features especially those that are functionally linked

Subtidal (sublittoral) mud & Sea-pen and White sea-slug communities	<p>SPWS communities are rarely known to occur at high densities on soft and very stable infralittoral SM, typically in shallow waters (up to 12m depth) (Hughes, 1998; OSPAR, 2010; JNCC, 2015). This biotope is confined to the most sheltered sea-loughs where the sediment has a proportion of fine mud greater than 80%. The slightly gravelly mud sediments in the pMCZ are particularly suitable for <i>V. mirabilis</i> as they tend to inhabit environments with low hydrodynamic energy and low-moderate current speeds (Greathead <i>et al.</i>, 2014). They can tolerate coarser sediments than other species of sea-pen due to their muscular peduncle that allows them to burrow easily (Greathead <i>et al.</i>, 2005).</p> <p>As a burrowing species, <i>V. mirabilis</i> is more dependent on the oxygen content of the substrate therefore sediments with high gravel content will have higher oxygen tensions due to the sediment permeability (Greathead <i>et al.</i>, 2014). Furthermore, the Sea-pen represents a diversity link, enhancing survival of smaller species and increasing the depth of oxygen penetration (Lancaster <i>et al.</i>, 2014). The bioturbation created by sea slugs and other occasional burrowers may increase the food supply for passive suspension feeding organisms such as <i>V. mirabilis</i> (Hughes, 1998; Hill <i>et al.</i>, 2010).</p>
2a Result	Guideline met.

Guideline 2b The Area of Search contains features with naturally high biodiversity (for habitats only)	
Subtidal (sublittoral) mud & Sea-pen and white sea-slug communities	<p>Within Carlingford Lough pMCZ the SM proposed broad scale habitat incorporates the biotope: SS.SMu.IFiMu.PhiVir – EUNIS A5.343 (SPWS: <i>P. aperta</i> and <i>V. mirabilis</i> in soft stable infralittoral mud). <i>P. aperta</i> is the most characteristic species of this habitat occurring at high densities, although it can be highly variable from year to year (JNCC, 2015). <i>V. mirabilis</i> appear in the pMCZ in particularly high numbers. The burrows created by the Sea-pens offer shelter, food and oxygen to a diverse range of small benthic infaunal organisms. <i>Ocnus planci</i>, a very rare sea cucumber has also regularly been observed in the pMCZ.</p> <p>Common epibenthic predators/scavengers occurring in this biotope include Shore crabs (<i>Carcinus maenas</i>), Edible crabs (<i>Cancer pagurus</i>), Swimming crabs (<i>Liocarcinus depurator</i>), Hermit crabs (<i>Pagurus bernhardus</i>) and Common starfish (<i>Asterias rubens</i>). Other species found on this shallow mud are the Spider crab (<i>Macropodia</i> sp.), Brittlestars (<i>Amphiurua filiformis</i>), Flat fish and Gobies. Sugar kelp (<i>Saccharina latissima</i>) is present though in low densities. Burrowing crustacean megafauna, characteristic of deeper mud, are rare but the Norway lobster (<i>Nephrops norvegicus</i>) has been occasionally recorded in the pMCZ (Hill & Wilson, 2005). The sediment also appears to be covered by a diatom film at certain times of the year.</p>
2b Result	Guideline met.
Guideline 2c The Area of Search contains coherent features not smaller fragmented ones	
Subtidal (sublittoral) mud & Sea-pen and White sea-slug communities	<p>There has been very little research on the natural spatial and temporal variability of SPWS communities in SM habitats. Evidence on Sea-pen population dynamics and longevity suggests that they are able to maintain a steady-state population with sporadic recruitment (Hill <i>et al.</i>, 2010). The Carlingford Lough SPWS communities have been found to be very dense and restricted to the inner area of the Lough; this is probably the only remaining part of the Lough not heavily impacted by human activity (refer to Conservation Objectives and potential Management Options paper for Carlingford Lough for further details). Sea-pen densities in the pMCZ have been recorded by DOE as abundant (10-19%) to superabundant (20-39%) on the SACFOR scale (JNCC, 2014) and White sea slug abundances from frequent (1-5%) to superabundant (20-39%). It is probable that historically Sea-pen were more widely distributed throughout Carlingford Lough. Spatial patchiness occurs due to localised differences in the sediment characteristics, for example organic enrichment.</p> <p>Camera and grab sample data confirms the presence of continuous SM habitat in the area comprising slightly gravelly mud. The pMCZ is considered to be stable and not fragmented; anthropogenic activities do not appear to have affected the suitability of the sediment for SPWS communities.</p>
2c Result	Guidelines met.

Guideline 2d The Area of Search contains features considered least damaged/more natural	
Subtidal (sublittoral) mud & Sea-pen and white sea-slug communities)	<p>No indication of change or damage to the pMCZ feature has been recorded inside the proposed boundaries from recent camera surveys carried out by AFBI (2012) and DOE (2015) (refer to the Data Confidence Assessment for further details). The proposed feature was assessed to be in a natural good condition within the pMCZ boundaries. However, due to insufficient data about the long-term trends of SPWS in SM it is not clear whether this has been adversely affected by anthropogenic activities in the past.</p> <p>The absence of SPWS in the AoS, outside the pMCZ boundary, suggests that SM may have been affected or modified by exposure to anthropogenic impacts reducing its suitability for SPWS colonisation. As such, the pMCZ remains the last area with natural undisturbed SM: SPWS habitat (refer to aquaculture licensed areas, shipping routes and 2009-2013 Vessel Monitoring System (VMS) data in the Conservation Objectives and potential Management Options for Carlingford Lough pMCZ paper).</p>
2d Result	Guidelines met.

Guideline 2e The Area of Search contains features at risk³ of damage by human activity	
Subtidal (sublittoral) mud & Sea-pen and white sea-slug communities)	<p>On the basis of the risk assessment (Annex A), undertaken at a local level of the Carlingford Lough AoS, this feature is considered to be at moderate risk of significant damage associated with anthropogenic activities occurring in the area. This is a result of potential exposure to pressures associated with aquaculture (shellfish farms and dredging present a moderate to high risk of damage), fishing (creeling and potting are considered to present a moderate to low risk), tourism and recreation (moderate risk), infrastructure development (considered to be a moderate risk), discharges and waste disposal (moderate risk), extraction or navigational dredging (moderate risk) and mooring and anchoring (considered to present a moderate risk).</p>
2e Result	Guidelines met.

³ Information on the sensitivity of the proposed biodiversity protected features to pressures and their associated activities was taken from Tillin *et al.* (2010), FEAST (Feature Activity Sensitivity Tool) <http://www.marine.scotland.gov.uk/FEAST/Index.aspx> and more developed sensitivity matrices by JNCC. The degree to which a feature is exposed to activities associated with pressures to which it is sensitive in each AoS/pMCZ region was assessed to provide a qualitative measure of risk. Risk assessments for the various activities were examined to produce an overall qualitative risk assessment by pMCZ region. The conclusions may not reflect the level of risk at the level of the possible pMCZ.

More detailed information on the process can be found on the papers: Guidance on the development of Conservation Objectives and potential Management Options and Conservation Objectives and potential Management Options for Carlingford Lough pMCZ. The risk assessment for Carlingford Lough pMCZ is included in Annex A.

Guideline 2f The Area of Search contains historic sites which could be restored

2f Result

Restoration of historic biotopes within Carlingford Lough would require revoking existing aquaculture licenses and engaging in subsequent habitat restoration.

Stage 3 - Assess the size of the Area of Search to ensure this is sufficient to maintain the integrity of features protected

Summary of assessment	The pMCZ reflects the distribution of SPWS communities and the range of SM suitable for colonisation by the main habitat component species. Although SPWS are present throughout Carlingford Lough, the highest concentration and the greatest continuous expanse within Northern Ireland waters lie within the pMCZ boundary. The proposed boundary is suitable for maintaining the integrity of the habitat feature for which the MCZ is being considered.
	Guideline met.

Detailed assessment

The size of the area of search should be adapted where necessary to ensure it is suitable for maintaining the integrity of the features for which the MCZ is being considered. Account should also be taken where relevant, of the need for effective management of relevant activities

Subtidal (sublittoral) mud & Sea-pen and white sea-slug communities	<p>The extent of SM: SPWS habitat records in the AoS is supported by the coverage of grab samples and PSA analysis, predictive habitat mapping (EU SeaMap 2014) and photographic/video evidence from underwater camera surveys (NISS; SSNI; AFBI Carlingford Lough 2012; DOE Carlingford Lough pMCZ support survey 2015; refer to details in the Data Confidence Assessment for Carlingford Lough pMCZ).</p> <p>The Carlingford Lough pMCZ boundary, originally drawn around the majority of SPWS in SM records in the inner part of the Lough, was amended to take into account the uses and activities occurring in the area, aiming for effective management within the proposed boundary.</p> <p>The proposed boundary incorporates a representative range of SM (slightly gravelly mud) supporting dense SPWS communities and takes into account advice from the aquaculture sector for potential management for the pMCZ. A buffer zone of 100m from aquaculture sites (north to south-east borders) was taken into consideration when developing the pMCZ boundary following pre-consultation discussion with industry representatives. This will enable shellfish operations to continue without impacting the conservation objectives or the integrity and diversity of the site. In addition, the administrative mid-line and navigational channel was taken into account for the southern border of the boundary.</p>
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Stage 4 - Assess the effectiveness of managing features within the proposed Area of Search

Summary of assessment	There is potential for management measures to be implemented successfully to achieve the conservation objectives of the pMCZ feature.
	Guideline met. As a result the original AoS and subsequent pMCZ progresses as potential area for MCZ to Stage 5.

Detailed assessment

There is a high probability that management measures, and the ability to implement them, will deliver the objectives of the MCZ

Subtidal (sublittoral) mud & Sea-pen and white sea slug communities)	<p>The conservation objective for the Carlingford Lough pMCZ feature is to <i>'maintain the feature in favourable condition'</i>. The current available evidence indicates that the communities of SPWS are in good condition within the pMCZ (see 2d); however, there are a number of activities (present and future) that are capable of adversely affecting the feature and therefore there is a need to consider whether additional management is required. This will aid in the achievement of the conservation objectives for the pMCZ feature (see 2e).</p> <p>There are mechanisms through the European Commission under the Fisheries Act (Northern Ireland) 1966 that can be used to support the introduction of spatial fisheries measures to conserve the feature of the pMCZ. Under the Marine and Coastal Access Act (2009), the Department has the responsibility for licensing certain activities; in some cases the Environmental Impact Assessment (EIA) process may be applicable. The Department also has the powers to introduce bye-laws if required under the Marine Act (Northern Ireland) 2013.</p> <p>The Conservation Objectives and Potential Management Options for Carlingford Lough pMCZ paper details the various activities likely to affect the pMCZ feature and suggested management options.</p> <p>The cross border nature of the site may present a risk to the management of the pMCZ. This may be controlled through cross-border institutions such as Loughs Agency.</p>
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Stage 5 - Assess the ecological coherence to prioritise between different areas based on the contribution to the MPA network

Summary of assessment	This is the only pMCZ put forward for SPWS communities as it is the only known example in Northern Ireland and one of the few records within the British Isles. Therefore the site contributes significantly to the MPA network. The site also makes a contribution towards the MPA network for the broad scale habitat SM, in OSPAR Region III.
	Guideline met.

Detailed assessment

The potential area contributes significantly to the coherence of the MPA network in the seas around Northern Ireland

Feature	Representation	Replication	Adequacy
Subtidal (sublittoral) mud & Sea-pen and white sea slug communities)	In the UK and Ireland, SPWS communities are restricted to the most sheltered sea loughs with full salinity conditions. The AoS is a stronghold as it contains the only known example of these communities in Northern Ireland and one of the few known in UK and Irish waters. The component species Sea-pen, <i>V. mirabilis</i> , is a Priority Species in Northern Ireland while the biotope SS.SMu.IFiMu.PhiVir is very similar to SS.SMu.CFiMu.SpnMeg , an OSPAR T&D habitat (OSPAR, 2010) but occurs shallower, is less stable, and is not characterised by burrowing megafauna (JNCC, 2014; Hughes, 1998). SM sediments are a key	Currently Sea-pen biotopes are not afforded direct protection under the existing network within Northern Ireland (some biotopes are afforded indirect protection under the Habitats Directive). There is replication for Sea-pen biotopes within the Irish Sea MPA. Replication of the SM in the network is proposed within OSPAR Region III.	Majority of records of SPWS are included within the pMCZ boundary. Also a large proportion of SM in the Lough is included in the pMCZ. A minimum regional proportion target of 15% of SM has been suggested for adequacy to support the network of MPAs (A5.3) (Natural England & JNCC, 2010). Currently, 17.52% of SM is protected within Northern Irish MPAs, thus the pMCZ would increase this percentage to 18.18%. (Barnard <i>et al.</i> 2014). The area of SM in Northern Ireland is 492km ² while 86.2km ² of this is currently protected in the existing MPA network.

	broad habitat supporting the SPWS communities. These are considered to be functionally linked and SM seabed is critical for Sea-pen colonisation.		The pMCZ will increase this area to 89.43km ² .
	Viability	Connectivity	Management
	The precautionary approach has been applied as there is very little information for the size of area required for a viable population of SPWS communities. Sea-pens have a small adult home range and large potential larval dispersal distances (approximately 10-40km) and so large areas (e.g. 1964km ²) would protect the whole life-cycle (Hill <i>et al.</i> , 2010). JNCC guidance suggests a minimum viable patch diameter of 1km (Natural England & JNCC, 2010). An area of 500m ² is thought to be appropriate to protect the viability of most species in the habitat. Additionally, it is recommended that where the feature occurs in a restricted location protection of the whole area or patch	Not applicable ⁴ . In NI the minimum distance between MPAs containing SM habitats is approximately 14.7km (within the 12nm region). Barnard <i>et al.</i> (2014) have stated that for NI where there is the same habitat type occurring in more than one of the MPAs located in the NI 12nm region then the minimum marine path between MPA centroids is estimated as being less than 32km for all relevant habitats. In the case of SPWS there is limited connectivity with other MPAs in NI as this habitat is not present elsewhere in the NI region.	There is potential for management measures to be implemented successfully to achieve the conservation objectives of the pMCZ feature such as fisheries measures, licensing activities and through bye-laws.

⁴ Connectivity between different regional networks and individual MPAs has only been assessed for some mobile species and large scale features. There is currently little evidence on linkages for low mobility species and sea-bed habitats in UK waters. More modelling work for assessing linkages is needed.

	<p>is required for viability (Hill <i>et al.</i>, 2010). The pMCZ boundary covers almost the entire SPWS extension with an area of 3.23km². The minimum diameter in the pMCZ is 1.06km.</p>		
	<p>Best available evidence</p>	<p>Economic, cultural and social issues</p>	
	<p>Best available evidence has been used to arrive at the decision regarding the feature and boundary development. Refer to Data confidence assessment for Carlingford Lough pMCZ for further details.</p>	<p>For further details refer to Conservation Objectives and potential Management Options for Carlingford Lough pMCZ paper and Regulatory Impact Assessment (RIA).</p>	

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Annex A

Sensitivity, exposure and vulnerability Matrix for Carlingford Lough pMCZ

Sensitivity and Exposure Key: ●●● High ●● Moderate ● Low ○ Not Sensitive ?No information

Vulnerability Key: High vulnerability Moderate vulnerability Low vulnerability No vulnerability Unknown

Table 1: Subtidal (sublittoral) mud (SM): Sea-pen and white sea slug communities (SPWS) Vulnerability Assessment

Pressure category	Pressures	Activities associated in the area	SM: SPWS		
			Sensitivity	Exposure	Vulnerability
Physical Loss	Physical loss	Infrastructure – coastal defence & land claim	●●●	●	Moderate Vulnerability
	Physical change (to another seabed type)	Infrastructure – ports, marinas, leisure facilities, cables, pipelines, coastal defence & land claim	●●	●	Low Vulnerability
		Aquaculture – shellfish		●●●	High Vulnerability
		Aquaculture – dredging		●●●	High Vulnerability
		Extraction – Maintenance dredging		●●●	High Vulnerability
Physical Damage	Siltation rate changes (low)	Aquaculture – shellfish	●	●●●	Moderate Vulnerability
		Infrastructure – ports, marinas, leisure facilities, cables, coastal defence & land claim		●	Low Vulnerability

		Discharges/waste disposal – waste water treatment plant & outfalls		•	Low Vulnerability	
	Siltation rate changes (high)	Extraction – Maintenance dredging		•••	High Vulnerability	
		Discharges/waste disposal – waste water treatment plant & outfalls	••	•	Low Vulnerability	
	Sub-surface abrasion/ penetration: damage to seabed surface and penetration ≤25mm	Infrastructure – ports, marinas, leisure facilities, cables, coastal defence & land claim			•	Low Vulnerability
		Extraction – Maintenance dredging	••	•••	High Vulnerability	
		Marine traffic – Moorings, anchoring & navigation		••	Moderate Vulnerability	
		Tourism & recreation		•	Low Vulnerability	
					•••	High Vulnerability
	Surface abrasion: damage to seabed surface features	Aquaculture – dredging			•••	High Vulnerability
		Fishing – creeling & potting			•••	High Vulnerability
		Aquaculture – shellfish	••		•••	High vulnerability
		Marine traffic – navigation			••	Moderate Vulnerability
		Tourism & recreation			•	Low Vulnerability
	Physical removal	Infrastructure –	••		•	Low

	(extraction of substratum)	pipes & cables			Vulnerability
		Extraction – Maintenance dredging		●●●	High Vulnerability
	Barrier to species movement (behaviour, reproduction)			○	No Vulnerability
	Death or injury by collision			○	No Vulnerability
Non-physical disturbance & Climate change	Litter		?		Unknown
	Introduction of light		?		Unknown
	Electromagnetic changes		○		No Vulnerability
	Underwater noise		○		No Vulnerability
	Visual disturbance (behaviour)		○		No Vulnerability
	Temperature changes - regional/national	Marine traffic – navigation	●●	?	Unknown
	Temperature changes - local		●●	?	Unknown
	Atmospheric climate change			○	No Vulnerability
	Emergence regime changes (sea level) - regional/national			○	No Vulnerability
	Emergence regime changes - local			○	No Vulnerability
	Water flow (tidal & ocean current) changes - regional/national		○		No Vulnerability
	Wave exposure changes -		○		No Vulnerability

	regional/national				
	Water flow (tidal current) changes - local		○		No Vulnerability
	Wave exposure changes - local		○		No Vulnerability
Toxic Contamination	Introduction of other substances (solid, liquid or gas)		?		Unknown
	Non-synthetic compound contamination (inc. heavy metals, hydrocarbons, produced water)	Discharges/ waste disposal – waste water treatment plant & outfalls		●	Low Vulnerability
		Infrastructure – coastal defence & land claim	●	●	Low Vulnerability
		Aquaculture – shellfish		●	Low Vulnerability
	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)		○		No Vulnerability
	Radionuclide contamination		○		No Vulnerability
Non-toxic Contamination	Organic enrichment	Aquaculture – shellfish		●●●	High Vulnerability
		Discharges/waste disposal – waste water treatment plant & outfalls	●●	●	Low Vulnerability
	Salinity changes - local	Infrastructure – coastal defence & land claim	●	●	Low Vulnerability
	Salinity changes -		○		No

	regional/national				Vulnerability
	pH changes		?	?	Unknown
	De-oxygenation	Aquaculture – shellfish		•	Low Vulnerability
		Discharges/ waste disposal – waste water treatment plant & outfalls	•	•	Low Vulnerability
	Nitrogen & phosphorus enrichment		○		No Vulnerability
	Water clarity changes		○		No Vulnerability
Biological Disturbance	Removal of target species (lethal)	Aquaculture – dredging		••	Moderate Vulnerability
		Fishing – creeling & potting	••	•	Low Vulnerability
	Removal of non-target species (lethal)	Aquaculture – dredging		••	Moderate Vulnerability
		Fishing – creeling & potting	••	•	Low Vulnerability
		Tourism & recreation		•	Low Vulnerability
	Genetic modification & translocation of indigenous species			○	No Vulnerability
	Introduction of microbial pathogens (disease)		○	?	No Vulnerability
	Introduction or spread of non-indigenous species & translocations (competition)	Aquaculture – shellfish		••	Moderate Vulnerability
Marine traffic – navigation		••	••	Moderate Vulnerability	

Risk of Damage Assessment for Carlingford Lough pMCZ

Risk Key: ■ High risk ■ Moderate risk ■ Low risk

Table 3: Subtidal (sublittoral) mud (SM): Sea-pen and white sea slug communities (SPWS) Risk of Damage Matrix (based on Vulnerability identified in Table 1).

SM: SPWS							
List of pressures which may cause deterioration or disturbance		Activity associated with pressure	Vulnerability	Is the current management adequate?*	Comments	Level of Risk	Action Advised
Physical loss	Physical loss	Infrastructure – coastal defence & land claim	Moderate Vulnerability	Yes	New developments require future management action (licensing/permits).	Low	- Reduce or limit new coastal defences or expansion where likely to impact the pMCZ features.
	Physical change (to another seabed type)	Infrastructure – ports, marinas, leisure facilities, cables, pipelines, coastal defence & land claim	Low Vulnerability	Yes	New developments require future action (licensing/permits).	Moderate	- Reduce or limit pressures associated with the Harbour works where likely to impact the pMCZ features. - Remove or avoid new developments where likely to

* This does not refer to any future activities or situations where active management is not required

							<p>impact the pMCZ features.</p> <ul style="list-style-type: none"> - Reduce or limit new coastal defences or expansion where likely to impact the pMCZ features.
		Aquaculture – shellfish	High Vulnerability	Yes	There are licensed sites surrounding the pMCZ, however, new applications require future action (licensing/permits).	Moderate	<ul style="list-style-type: none"> - Remove or avoid new shellfish farms or expansion/relocation of the existing ones where likely to impact the pMCZ features. - Reduce or limit existing pressures. A buffer zone of 100m from the aquaculture farms was taken into consideration when developing the pMCZ boundary which should enable routine operations without impacting the conservation objectives.

		Aquaculture – dredging	High Vulnerability	Yes	There are licensed sites surrounding the pMCZ, however, new applications require future action (licensing/permits).	High	- Remove or avoid dredge gear fishing inside the pMCZ.
		Extraction – Maintenance dredging	High Vulnerability	Yes	New applications require future action (licensing/permits).	Moderate	- Remove or avoid new extraction activities where they are likely to impact the pMCZ features
		Aquaculture – shellfish	Moderate Vulnerability	Yes	There are licensed sites surrounding the pMCZ, however, new applications require future action (licensing/permits).	Low	- Remove or avoid new shellfish farms or expansion/relocation of the existing ones - Reduce or limit existing pressures. A buffer zone of 100m from the aquaculture farms was taken into consideration when developing the pMCZ boundary which should enable routine operations without impacting
Physical damage	Siltation rate changes (low)						

							the conservation objectives.
		Infrastructure – ports, marinas, leisure facilities, cables, pipelines, coastal defence & land claim	Low Vulnerability	Yes	New developments require future action (licensing/permits).	Low	<ul style="list-style-type: none"> - Reduce or limit pressures associated with the Harbour works where likely to impact the pMCZ features. - Remove or avoid new developments where likely to impact the pMCZ features. - Reduce or limit new coastal defences or expansion where likely to impact the pMCZ features.
		Discharges/waste disposal – waste water treatment plant & outfalls	Low Vulnerability	Yes	New developments require future management action (licensing/permits).	Low	<ul style="list-style-type: none"> - Remove or avoid new waste water discharges and dredge disposal and expansion or relocation of existing disposal activities where likely to impact the pMCZ features.

	Siltation rate changes (High)	Extraction – Maintenance dredging	High Vulnerability	Yes	New applications require future action (licensing/permits).	Moderate	- Remove or avoid new extraction activities where they are likely to impact the pMCZ features.
		Discharges/waste disposal – waste water treatment plant & outfalls	Low Vulnerability	Yes	New developments require future management action (licensing/permits).	Low	- Remove or avoid new waste water discharges and dredge disposal and expansion or relocation of existing disposal activities where likely to impact the pMCZ features.
	Sub-surface abrasion/penetration: damage to seabed surface and penetration ≤25mm	Infrastructure – ports, marinas, leisure facilities, cables , coastal defence & land claim	Low Vulnerability	Yes	New developments require future management action (licensing/permits).	Low	- Reduce or limit pressures associated with the Harbour works where likely to impact the pMCZ features. - Remove or avoid new developments where likely to impact the pMCZ features. - Reduce or limit new coastal defences or expansion where

							likely to impact the pMCZ features.
		Extraction – Maintenance dredging	High Vulnerability	Yes	New applications require future action (licensing/permits).	Moderate	- Remove or avoid new extraction activities where they are likely to impact the pMCZ features.
		Marine traffic – moorings, anchoring & navigation	Moderate Vulnerability	No	No site specific management of this activity in place.	Moderate	- Remove or avoid anchoring and moorings inside the pMCZ
		Tourism & recreation	Low Vulnerability	No	No site specific management of these activities in place.	Moderate	- Reduce or limit tourism & recreational pressures where likely to impact the pMCZ features. - Remove or avoid anchoring and moorings inside the pMCZ
	Surface abrasion: damage to seabed surface features	Aquaculture – dredging	High Vulnerability	Yes	There are licensed sites surrounding the pMCZ, however, new applications require future action	Moderate	- Remove or avoid dredge gear fishing inside the pMCZ

					(licensing/permits).		
		Fishing – creeling & potting	High Vulnerability	No	No site specific management of this activity in place.	High	- Remove or avoid creeling and potting activities where they are likely to impact the pMCZ features
		Aquaculture – shellfish	High Vulnerability	Yes	There are licensed sites surrounding the pMCZ, however, new applications require future action (licensing/permits).	High	- Remove or avoid new shellfish farms or expansion/relocation of the existing ones - Reduce or limit existing pressures. A buffer zone of 100m from the aquaculture farms was taken into consideration when developing the pMCZ boundary which should enable routine operations without impacting the conservation objectives.
		Marine traffic – navigation	Moderate Vulnerability	Yes		Low	- No action required at present
		Tourism &	Low	No	No site specific	Moderate	- Reduce or limit

		recreation	Vulnerability		management of these activities in place.		tourism & recreational pressures where likely to impact the pMCZ features. - Remove or avoid anchoring and moorings inside the pMCZ
	Physical removal (extraction of substratum)	Infrastructure – cables & pipelines	Low Vulnerability	Yes	New developments require future action (licensing/permits).	Low	- Remove or avoid new cables/pipelines where likely to impact the pMCZ features
		Extraction – Maintenance dredging	High Vulnerability	Yes	New applications require future action (licensing/permits).	Moderate	- Remove or avoid new extraction activities where they are likely to impact the pMCZ features.
Toxic Contamination	Non-synthetic compound contamination (inc. heavy metals, hydrocarbons, produced water)	Discharges/waste disposal – waste water treatment plant & outfalls	Low Vulnerability	Yes	New developments require future management action (licensing/permits).	Low	- Remove or avoid new waste water discharges and dredge disposal and expansion or relocation of existing disposal activities where likely to impact the pMCZ features.

		Infrastructure – coastal defence & land claim	Low Vulnerability	Yes	New developments require future management action (licensing/permits).	Low	<ul style="list-style-type: none"> - Reduce or limit pressures associated with the Harbour works where likely to impact the pMCZ features. - Remove or avoid new developments where likely to impact the pMCZ features. - Reduce or limit new coastal defences or expansion where likely to impact the pMCZ features.
		Aquaculture – shellfish	Low Vulnerability	Yes	New applications require future action (licensing/permits).	Low	<ul style="list-style-type: none"> - Remove or avoid new shellfish farms or expansion/relocation of the existing ones - Reduce or limit existing pressures. A buffer zone of 100m from the aquaculture farms was taken into consideration when developing the

							pMCZ boundary which should enable routine operations without impacting the conservation objectives.
Non-toxic Contamination	Organic enrichment	Aquaculture – shellfish	High Vulnerability	Yes	There are licensed sites surrounding the pMCZ, however, new applications require future action (licensing/permits).	Moderate	<ul style="list-style-type: none"> - Remove or avoid new shellfish farms or expansion/relocation of the existing ones - Reduce or limit existing pressures. A buffer zone of 100m from the aquaculture farms was taken into consideration when developing the pMCZ boundary which should enable routine operations without impacting the conservation objectives.
		Discharges/waste disposal – waste water treatment	Low Vulnerability	Yes	New developments require future management action	Low	- Remove or avoid new waste water discharges and dredge disposal and

		plant & outfalls			(licensing/permits).		expansion or relocation of existing disposal activities where likely to impact the pMCZ features.
	Salinity changes - local	Infrastructure – coastal defence & land claim	Low Vulnerability	Yes	The pMCZ is located in open water with strong tidal flow; salinity changes are highly unlikely to occur.	Low	-Remove or avoid new developments where they are likely to impact the pMCZ features
	De-oxygenation	Aquaculture – shellfish	Low Vulnerability	Yes	There are licensed sites surrounding the pMCZ, however, new applications require future action (licensing/permits).	Low	- Remove or avoid new shellfish farms or expansion/relocation of the existing ones - Reduce or limit existing pressures. A buffer zone of 100m from the aquaculture farms was taken into consideration when developing the pMCZ boundary which should enable routine operations without impacting the conservation

							objectives.
		Discharges/waste disposal – waste water treatment plant & outfalls	Low Vulnerability	Yes	New developments require future management action (licensing/permits).	Low	- Remove or avoid new waste water discharges and dredge disposal and expansion or relocation of existing disposal activities where likely to impact the pMCZ features.
Biological disturbance	Removal of target species (lethal)	Aquaculture – dredging	Moderate Vulnerability	Yes	There are licensed sites surrounding the pMCZ, however, new applications require future action (licensing/permits).	Low	- Remove or avoid dredge gear fishing inside the pMCZ
		Fishing – creeling & potting	Low Vulnerability	No	No site specific management of this activity in place.	Moderate	- Reduce or limit pressure where they are likely to impact the pMCZ feature

	Removal of non-target species (lethal)	Aquaculture – dredging	Moderate Vulnerability	Yes	There are licensed sites surrounding the pMCZ, however, new applications require future action (licensing/permits).	Low	- Remove or avoid dredge gear fishing inside the pMCZ
		Fishing – creeling & potting	Low Vulnerability	No	No site specific management of this activity in place.	Moderate	- Reduce or limit pressure where they are likely to impact the pMCZ feature
		Tourism & recreation	Low Vulnerability	No	No site specific management of these activities in place.	Moderate	- Reduce or limit tourism & recreational pressures where likely to impact the pMCZ features. - Remove or avoid anchoring and moorings inside the pMCZ
	Introduction or spread of non-indigenous species & translocations (competition)	Aquaculture – shellfish	Moderate Vulnerability	Yes	There are licensed sites surrounding the pMCZ, however, new applications require future	Moderate	- Remove or avoid new shellfish farms or expansion/relocation of the existing ones - Reduce or limit

					action (licensing/permits).		existing pressures. A buffer zone of 100m from the aquaculture farms was taken into consideration when developing the pMCZ boundary which should enable routine operations without impacting the conservation objectives.
		Marine traffic – navigation	Moderate Vulnerability	Yes		Low	- No action required at present



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