BMT WBM

"Where will our knowledge take you?"

Hawkesbury Shelf Marine Bioregion Threat and Risk Assessment Report

Reference: R.N20470.001.01 docx

Date: October 2015

Hawkesbury Shelf Marine Bioregion Threat and Risk Assessment Report

Prepared for:	Marine Estate Management Authority
Prepared by:	BMT WBM Pty Ltd (Member of the BMT group of companies)

Offices

Brisbane
Denver
London
Mackay
Melbourne
Newcastle
Perth
Sydney
Vancouver

Document Control Sheet

BMT WBM Pty Ltd
Level 8, 200 Creek Street
Brisbane Qld 4000
Australia
PO Box 203, Spring Hill 4004

Tel: +61 7 3831 6744
Fax: + 61 7 3832 3627

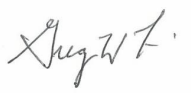
ABN 54 010 830 421

www.bmtwbm.com.au

Document:	R.N20470.001.01.docx
Title:	Hawkesbury Shelf Marine Bioregion Threat and Risk Assessment Report
Project Manager:	Greg Fisk
Author:	Greg Fisk, Michelle Fletcher
Client:	Marine Estate Management Authority
Client Contact:	Bob Creese
Client Reference:	DTIRIS 15/265

Synopsis: **A report summarising the threat and risk assessment process and outcomes undertaken for the Hawkesbury Shelf Marine Bioregion with MEMA agencies and independent experts.**

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by		Issued by	
00 (draft report)	16 September 2015	MF		GWF	
01 (final draft report)	9 October 2015	MF		GWF	
02 (final report)	30 October 2015	MF		GWF	

DISTRIBUTION

Destination	Revision										
	0	1	2	3	4	5	6	7	8	9	10
Marine Estate Management Authority	PDF	PDF	PDF								
BMT WBM File	PDF	PDF	PDF								
BMT WBM Library	PDF	PDF	PDF								

Photos used in this report have been sourced from the document, 'Threat and Risk Assessment Framework for the NSW Marine Estate' (2015) and are courtesy of Department of Planning and Environment, Office of Environment and Heritage, Transport for NSW, and Department of Primary Industries.

Executive Summary

The Marine Estate Management Authority (MEMA) outlined a new approach to marine estate management via the release of the document, 'Managing the Marine Estate: Purpose, Underpinning Principles and Priority Setting' (the Principles Paper) in 2013. The Principles Paper outlines that the NSW marine estate is to be managed as a single continuous system for the greatest well-being of the community. This initiative is based on maximising current and future economic, social and environmental benefits.

MEMA has developed a 5-step decision making framework under the new approach to marine estate management. The second step of the 5-step approach (following engagement with key stakeholders and the community in step one to identify key benefits) includes a thorough assessment process, in order to consider and prioritise the social, cultural, economic and environmental threats to community benefits to inform future management responses at varying scales. This process is called the Threat and Risk Assessment or TARA. This report outlines the key findings of the TARA undertaken for the Hawkesbury Shelf marine bioregion (HSMB) which is being treated as a pilot for application of the process across the State.

The overall role of TARA is to help determine whether existing management controls maximise, in aggregate, the estate's economic, social and environmental benefits. MEMA's threat and risk assessments are, therefore, more appropriately framed in terms of risk being the effect of uncertainty on community wellbeing, which comprises economic, social and environmental benefits to the community.

Accordingly, the TARA for the HSMB includes an assessment of threats from uses, activities and stressors to a broad range of environmental assets such as clean water, marine habitats and protected species and communities on the coastline and marine waters as well as in the bioregion's estuaries.

The TARA has also sought to identify risks to social and economic benefits derived from the marine estate in the bioregion across a broad range of uses and activities including various forms of fishing, recreational activities such as boating, aquaculture, shipping, tourism, coastal development and similar.

The social benefits from these uses and activities that were assessed included participation benefits, enjoyment benefits and cultural heritage & use benefits.

Economic benefits from these uses and activities that were assessed included: indirect economic values such as the intrinsic & bequest values derived from the marine estate; economic benefits related to employment and the value of production; and benefits related to direct economic values such as individual enjoyment value or consumer surplus.

The threat and risk matrix adopted for use in the assessment was taken from the document, '*Threat and Risk Assessment Framework for the NSW Marine Estate*' (MEMA 2015a) and is shown generically in Table 1-1.

Table 1-1 Example Threat and Risk Assessment Matrix

THREATS	BENEFIT 1	BENEFIT 2	BENEFIT 3	BENEFIT 4
THREAT 1	HIGH	HIGH	MINIMAL	LOW
THREAT 2	LOW	MINIMAL	MINIMAL	MINIMAL
THREAT 3	MODERATE	LOW	LOW	MINIMAL
THREAT 4	MODERATE	MODERATE	MINIMAL	MODERATE

Using this approach, four 'risk ratings' under the TARA are possible – 'Minimal' (green), 'Low' (yellow), 'Moderate' (orange) or 'High' (red).

Taken together with the risk matrices and evidentiary information presented in the Appendices to this report, this first pass approach to the TARA for the HSMB has produced a comprehensive set of threats, benefits, and initial risks ratings (and associated evidence) that can be reviewed and further developed over time.

When considering the risk of threats to the **environmental assets** (and associated environmental benefits) of the marine estate:

- For the coastline and marine areas of the bioregion, there were 17 instances where the risk of the threat being realised was rated as having a 'High' risk to environmental assets. There were 21 instances where the risk of the threat being realised was rated as having a 'Moderate' risk to environmental assets.
- For the estuaries in the bioregion, there were 40 instances where the risk of the threat being realised was rated as having a 'High' risk to environmental assets. There were 36 instances where the risk of the threat being realised was rated as having a 'Moderate' risk to environmental assets.
- As evidenced by the above, there are more and higher risks from threats to environmental assets in the estuaries compared to environmental assets of the coastline and marine areas.
- In considering spatial and temporal aspects, most key risks to environmental assets are considered to be operating at a whole of bioregion scale and are current issues that are happening now (e.g. at the present time) with the threat of the risk being realised expected to intensify or increase over time.
- Activities and issues generating highest threat to environmental assets of the bioregion were:
  - Climate change (50 year timeframe)
  - Urban stormwater discharge
  - Clearing, dredging & excavation activities
  - Shipping
  - Recreation & tourism

- Recreational boating & boating infrastructure
- Foreshore development
- Agriculture diffuse source runoff
- Point discharges
- Estuary opening/modified freshwater flows
- Recreational fishing
- Commercial fishing
- Aquaculture
- Charter fishing
- Charter activities

When considering the risk of threats to the **social and economic benefits** derived from the uses and activities of the marine estate:

- There was a high proportion of 'Moderate' risks compared to other risks attributed for the social and economic benefits. The risk of the threat being realised to an identified social or economic benefit included:
  - 60 instances where the risk of the threat being realised was identified as a 'High' risk; and
  - 283 instances where the risk of the threat being realised was identified as a 'Moderate' risk
- Similar to the environmental assessment, most of these risks to social and economic benefits are considered to be operating across the bioregion and are current issues that are happening now (e.g. at the present time) with the threat of the risk being realised expected to intensify or increase over time.
- Activities and issues generating highest threat to social and economic benefits of the bioregion were:
  - Effect of Regulation
  - Access Availability
  - Climate Change (50 year timeframe)
  - Recreational Fishing
  - Commercial Fishing
  - Sediment Contamination / Water Pollution
  - Recreation and Tourism
  - Foreshore Urban Development
  - Reductions in abundancies of top and lower order trophic levels (depletion of fish stocks)
  - Habitat Disturbance (loss of fish habitat)

- Pests and Disease
- Recreational Boating
- Funding
- Health and Safety
- Cultural Fishing
- Aquaculture
- Modified Freshwater flows / Estuary entrance management
- Shipping
- Adverse Wildlife Interaction

When considering threats to the **full suite of benefits** provided by the marine estate (environment, social and economic) in the bioregion:

- 'Climate Change' (over a fifty year planning period) was clearly seen by participants in the TARA as the threat that poses the greatest risk to the assets and benefits provided by the marine estate with the largest number of high risks and moderate risks.
- 'Water Pollution and Sediment Quality' was the next greatest risk, rating highly on the basis that it affects the broadest range of assets, uses and activities and has a large number of high, moderate and low risks.
- 'Commercial Fishing', 'Recreational Fishing', 'Urban Development', 'Shipping and Commercial Vessels' and 'Clearing, Dredging and Excavation Activities' have similar risk profiles; with a small number of high risks but a large number of moderate risks, with many of the moderate risks crossing over several social and economic benefit categories.
- 'Recreational Boating', 'Modified Freshwater Flows and Estuary Opening', and 'Recreation and Tourism' could be grouped together on the basis that while still presenting high and moderate risks to some benefits, the overall number of risks is somewhat less than the above category.
- 'Aquaculture' and 'Cultural Fishing' were considered lower overall risks to the benefits provided by the marine estate but still contain particular aspects of high risk and moderate risks that required consideration in the next steps of the decision making process.

It should be recognised that the TARA and its outputs as outlined in this report are a tool for the prioritisation of risks for treatment that will be further assessed. In this context, assignment of a 'High' or 'Moderate' risk level is a trigger for further interrogation of the threat to an asset or benefit but will not necessarily lead to a change to current management or regulations.

MEMA will use the outputs of the TARA to evaluate the assigned risks through a risk evaluation process with a view to determining appropriate tolerance levels and treatment options.

Contents

List of Figures

List of Tables

Contents

1 Introduction

1.1 Background

The NSW Government commissioned an Independent Scientific Audit of Marine Parks in NSW (the Audit) in mid-2011 which concluded that management of the marine estate required changes to governance arrangements and policy objectives, particularly in order to reduce social conflict and improve effective management of coastal and marine resources beyond existing marine parks (Beeton et. al. 2012).

Consistent with the Audit recommendations, the NSW Government implemented a new approach to sustainable management of the NSW marine estate, including all marine waters, estuaries and coastal areas and the State's six marine parks. The *Marine Estate Management Act 2014* provides for strategic and integrated management of the whole marine estate.

In response to the findings of the Audit, the Government also established a new advisory Marine Estate Management Authority (MEMA or the Authority), which comprises representation from the four main government agencies involved in marine estate management and an independent Chair. The four government agencies are the Office of Environment and Heritage, Department of Industry, Department of Transport, and Department of Planning and Environment. It also appointed an independent Marine Estate Expert Knowledge Panel (MEEKP) to provide expert advice spanning ecological, economic and social sciences to underpin evidence based decision making.

The Authority outlined its new approach to marine estate management via the release of the document, *'Managing the Marine Estate: Purpose, Underpinning Principles and Priority Setting'* (the Principles Paper). The Principles Paper outlines that the NSW marine estate is to be managed as a single continuous system for the greatest well-being of the community. This initiative is based on maximising current and future economic, social and environmental benefits.

The Authority has developed a 5-step decision making framework under the new approach to marine estate management as shown in Figure 1-1.

In summary, these steps are to:

(1) Identify key benefits and threats to those benefits that the estate provides to the NSW community;

(2) Assess and assign risks to those threats so that management efforts can be focused on the most important issues;

(3) Assess the adequacy of current management settings and alternative options for addressing priority threats;

(4) Implement the most efficient management settings; and

(5) Be accountable to the NSW community in terms of monitoring the effectiveness of management settings.

Step 1	HOW THE COMMUNITY BENEFITS FROM THE ESTATE	Identify key economic, social and environmental benefits, and perceived threats and opportunities derived from the Estate	Develop ongoing engagement strategy: ■ community consultation ■ expert input ■ stakeholder surveys	*Principle 1*
Step 2	ASSESS THREATS AND RISKS TO BENEFITS	Expert assessment of threats and opportunities to the key economic, social and environmental benefits	Prioritise threats based on their likelihood and consequence and consider relevant scale: ■ local ■ regional ■ state-wide	*Principle 2*
Step 3	ASSESS MANAGEMENT OPTIONS TO MAXIMISE BENEFITS	Identify and assess current and potential management settings in delivering benefits to the community	Apply values to economic, social and environmental benefits of alternative uses. Assess which options deliver maximum benefit to the community.	*Principles 1, 3, 4, 5, 6 & 7*
Step 4	IMPLEMENT PREFERRED MANAGEMENT OPTIONS	Implement options that maximise overall benefits to the NSW community as a whole	Identify the most efficient and cost-effective management options. Design measurable performance indicators. *Develop strategic monitoring program to measure outcomes relative to the vision.*	*Principles 1 & 8*
Step 5	BE ACCOUNTABLE	Monitor, measure and report on performance *Review progress*	Report transparently to the community. Promote strategic research to inform management and enhance future outcomes. *Examine performance, including benefit, threat and risk status periodically.* *Review management arrangements for those not achieving adequate performance.*	*Principles 1, 9 & 10*

Figure 1-1 MEMA Five Step Decision Making Process

The decision making process is being applied to the marine estate at a statewide level, as well as at the bioregional level, with the initial study focussed on the Hawkesbury Shelf marine bioregion (HSMB). The assessment will identify options for enhancing marine biodiversity conservation, while also achieving balanced outcomes including opportunities for other community benefits and uses of the marine estate within the bioregion.

As part of Step 1, the Authority commenced engagement with the NSW community and visitors by surveying their views on the marine estate. The Marine Estate Community Survey (Sweeney Research 2014) identified key environmental, social and economic values and benefits derived from the NSW marine estate as well as key threats and opportunities.

The community survey was an important first step in identifying the environmental, social, cultural and economic key values, benefits and threats. The results of the survey have been collated by MEMA at both the statewide and Hawkesbury Shelf bioregional scales (MEMA 2015b). Peak stakeholder workshops and Aboriginal engagement workshops were also held in Step 1 by MEMA agencies to inform bioregion-specific views on values, benefits, threats and opportunities.

With Step 1 now complete, Step 2 of the 5-step approach includes a thorough assessment process, in order to consider and prioritise the social, cultural, economic and environmental threats to community benefits to inform future management responses at varying scales. This process is called the Threat and Risk Assessment or TARA.

This report outlines the key findings of the TARA undertaken for the HSMB.

1.2 Purpose and Structure of this Report

The key steps of the decision making process for the HSMB assessment are shown graphically in Figure 1-2, with this report representing the box in the diagram called 'threat and risk assessment report'. As shown in the diagram, the report follows the preparation of extensive background reports on the threats to the key benefits of the marine estate for the bioregion and a series of interactive workshops with MEMA agencies and independent experts to identify the risk of these threats to the benefits being realised.

Accordingly, the purpose of this report is to document the methodologies used, workshop proceedings and key outputs of the TARA process in the form of evidence-based risk ratings for threats to the environment, social and economic benefits provided by the marine estate for the bioregion.

This process has been used to assess and assign risks to the key threats operating in the bioregion such that management options and responses can be focused on the most important issues in the next phase of planning for the marine estate.

The report is set out as follows:

Section 2 Methods

Section 3 Findings of the Environment Risk Assessment

Section 4 Findings of the Social and Economic Risk Assessment

Section 5 Integrating the Environmental, Social and Economic Assessments

Section 6 Conclusions and Recommendations

Section 7 References

1.3 Planning Area

The Hawkesbury Shelf Marine Bioregion extends from Newcastle in the north to Shellharbour in the south and includes the coastline, estuaries, coastal lakes and lagoons, beaches and ocean waters out to the edge of the continental shelf.

The seaward boundary of the planning area is three nautical miles (the limit of state waters). The landward boundary of the planning area includes coastal and estuarine waters to the limit of tidal influence but also includes adjoining land uses and activities that could affect the marine estate.

The Planning Area is shown in Figure 1-3.

1.4 Glossary

A glossary of key terms (produced by MEMA) is provided in Appendix E of this report.

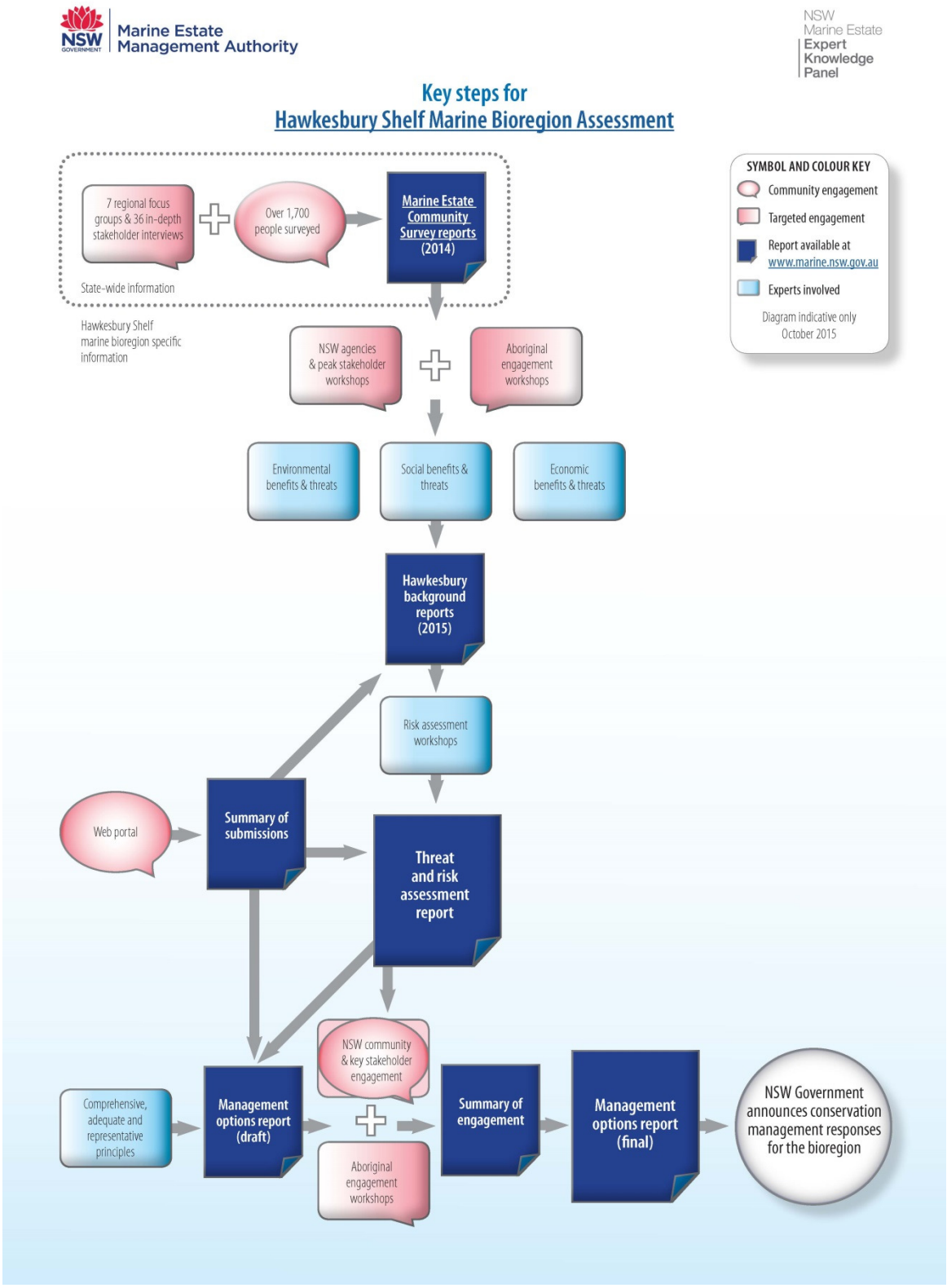


Figure 1-2 Key Steps - Hawkesbury Shelf Marine Bioregion Assessment

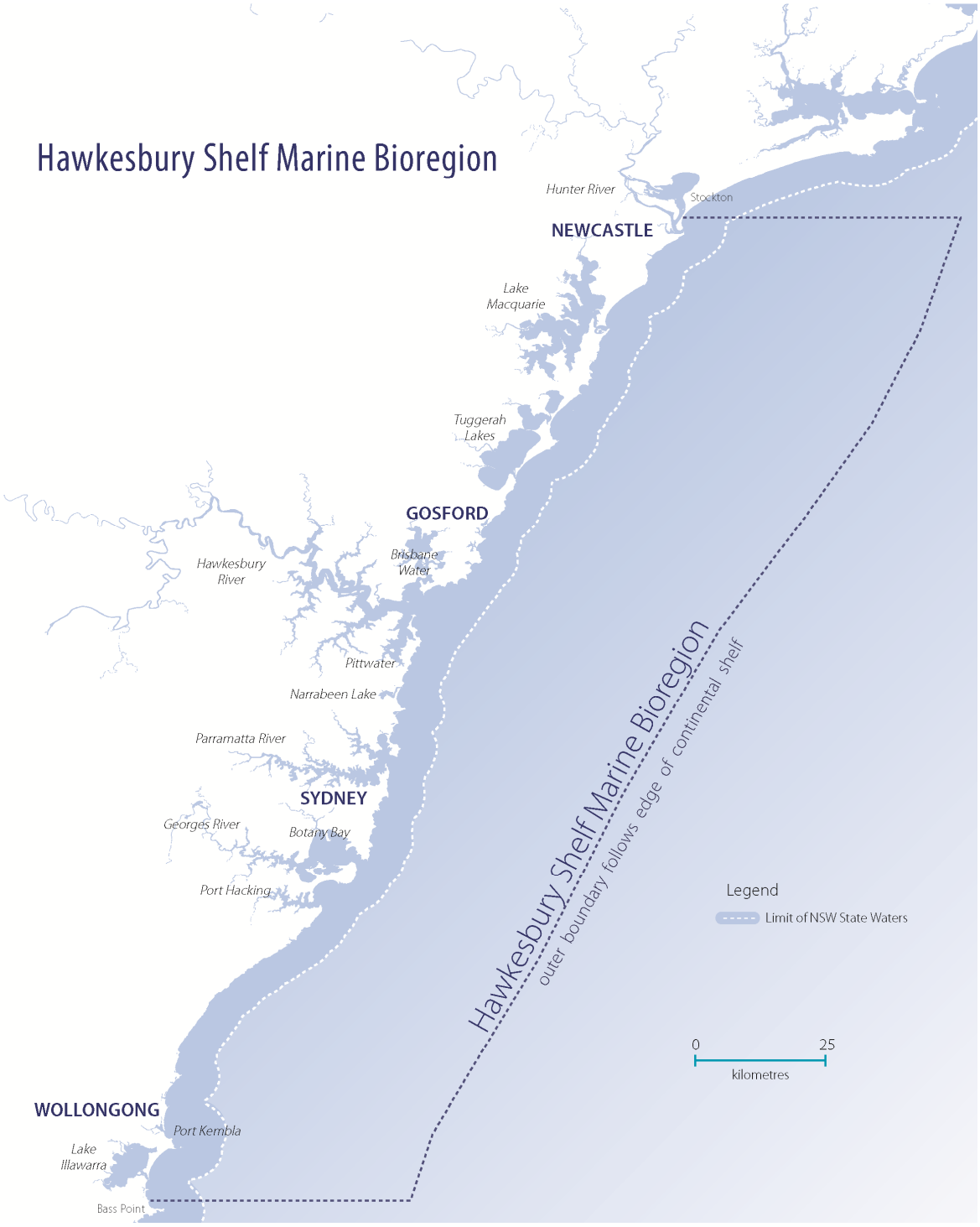


Figure 1-3 Planning Area for the Hawkesbury Shelf Marine Bioregion

2 Methods

2.1 Threat and Risk Assessment process (TARA)

The TARA is designed to:

- Be undertaken at a range of scales from statewide down to the geographic region that best aligns with the management issue being investigated;
- Provide transparency and ease of understanding to stakeholders;
- Draw on a range of credible and accepted information sources; and
- Accommodate whatever level of analysis is 'fit for purpose', from broad, qualitative, 'scanning' assessments, down to in-depth quantitative analyses, where more detailed assessments provide necessary further information for decision making.

Further information about the TARA process can be sourced from the document entitled, '*Threat and Risk Assessment Framework for the NSW Marine Estate*' (MEMA 2015a) available from http://www.marine.nsw.gov.au/key-initiatives/threat-and-risk-assessment-framework.

Essentially, the TARA seeks to identify how various activities may affect environment, social or economic benefits that accrue from the marine estate (as shown in Table 2-1). A risk assessment process (in accordance with AS/NZS ISO 31000:2009) is embedded within the TARA process, and is used to assess the risk of a threat to a community benefit *being realised*. It also includes a consideration of the magnitude of the potential consequences and the likelihood that those consequences will occur given current management controls.

Table 2-1 Example of a Threat and Risk Assessment Matrix from MEMA (2015a)

THREATS	BENEFIT 1	BENEFIT 2	BENEFIT 3	BENEFIT 4
THREAT 1	HIGH	HIGH	MINIMAL	LOW
THREAT 2	LOW	MINIMAL	MINIMAL	MINIMAL
THREAT 3	MODERATE	LOW	LOW	MINIMAL
THREAT 4	MODERATE	MODERATE	MINIMAL	MODERATE

As outlined in MEMA 2015, the overall role of TARA is to help determine whether existing management controls maximise, in aggregate, the estate's community benefits. MEMA's threat and risk assessments are, therefore, more appropriately framed in terms of risk being the effect of uncertainty on community wellbeing.

The findings of the TARA will provide data on the likely magnitude and direction of change in benefits under existing management controls. This is vital information for assessing proposed management options in step 3 of the MEMA 5-step decision-making process.

2.2 Risk Tables and Assessment Matrix

The risk goals, objectives and definitions of consequence and likelihood definitions that were used in the TARA were drafted by MEMA agencies with input from the MEEKP.

Appendix A sets out the overall goals and objectives, consequence and likelihood definitions that were used in the HSMB.

To reflect the triple bottom line nature of the assessment, specific goal statements, objective statements and consequence definitions were prepared for the environmental, social and economic aspects of the TARA, with a common likelihood definitions used across all three assessments. The risk goals and objectives are consistent with the legislative objectives administered by MEMA agencies and the vision for NSW marine estate of a "healthy coast and sea, managed for the greatest well-being of the NSW community, now and into the future (MEMA 2015) (refer Appendix A).

The risk matrix adopted for use in all assessments was taken from the document, '*Threat and Risk Assessment Framework for the NSW Marine Estate*' (MEMA 2015a) and is reproduced in Table 2-2.

Table 2-2 Risk Rating Used in Assessments

LIKELIHOOD	LEVEL OF RISK				
ALMOST CERTAIN	MINIMAL	LOW	MODERATE	HIGH	HIGH
LIKELY	MINIMAL	LOW	MODERATE	HIGH	HIGH
POSSIBLE	MINIMAL	MINIMAL	LOW	MODERATE	HIGH
UNLIKELY	MINIMAL	MINIMAL	MINIMAL	LOW	MODERATE
RARE	MINIMAL	MINIMAL	MINIMAL	MINIMAL	LOW
CONSEQUENCE LEVEL	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC

Using this risk matrix, four 'risk ratings' are possible – 'Minimal' (green), 'Low' (yellow), 'Moderate' (orange) or 'High' (red). It was agreed that a fifth rating of 'Positive' could be assigned as part of the TARA noting not all interactions between threat activities and benefits would necessarily be adverse. Positive risks would be shown in blue in the context of the TARA matrices.

2.3 Benefit Categories

The TARA uses the term 'community benefit' and defines this term as anything that contributes to the wellbeing of the community. There are three separate categories of community benefits: economic, social and environmental benefits. Community benefits are based on what people think is important (what they value). A community benefit of the marine estate can include:

- Swimming at the beach;
- Boating in an estuary;
- Doing something as a hobby (e.g. fishing, kayaking, surfing, bird watching, etc.);

- Running a business (e.g. whale watching business, charter fishing, commercial fishing, etc.); and
- Clean waters and marine biodiversity.

For the purpose of the TARA, a carefully considered categorisation of benefits was identified across the environment, social and economic matrices.

These benefit categories were developed and agreed by the MEMA agencies based on the community survey and other information sources and then further refined as part of the workshop processes.

The agreed benefit categories were as follows:

Environmental Assets that Provide Environmental Benefits

Environmental assets are the natural attributes, components and living resources of the marine estate. Environmental benefits are those benefits derived by the community from the marine estate's environmental assets and can include, for example, products obtained from the estate such as food, benefits related to the regulation of ecosystem processes such as climate regulation and nutrient cycling, and ecosystem services such as biodiversity.

The environmental asset categories adopted for the TARA included the following:

- **Clean Waters** (with sub-categories of estuarine and marine (e.g. oceanic) waters)
- **Habitats and Assemblages** (with sub-categories of oceanic beaches, saltmarsh, mangroves, seagrass, estuarine beach and mud flats, shallow and deep soft sediments, rocky shores, subtidal reefs, deep reefs, and pelagic habitats)
- **Threatened and Protected Species** (with sub-categories of species, populations and ecological communities listed as protected or threatened under the *NSW Fisheries Management Act 1994* [fish, marine invertebrates and marine vegetation] (FMA), the *NSW Threatened Species Conservation Act 1995* [such as cetaceans, turtles, shorebirds, and other marine megafauna] (TSC Act).

Uses and Activities that Provide Social and Economic Benefits

In determining the social and economic benefits derived from the marine estate, the uses and activities that occur in the marine estate were identified and adopted for the TARA were as follows:

- **Cultural Fishing**
- **Recreational Fishing**
- **Commercial Fishing**
- **Aquaculture**
- **Recreation**
- **Recreational Boating**
- **Research & Education**

- **Conserving Environment and Heritage**
- **Cruise Shipping**
- **Ports & Shipping**
- **Commercial Boating and Charters**
- **Maritime Related Activities and Infrastructure**
- **Tourism & Accommodation**
- **Coastal Urban Settlement**
- **Retail and Trade**
- **Water Transport Services**
- **Marine extraction and offshore disposal activities.**

Further definitions of what each of these use and activity categories include and do not include are provided in Appendix D.

For each of the use and activity categories listed above, benefits were identified under the following standard categories:

Social

- **Participation benefits** (with further sub-categories of 'Safety, Health & Wellbeing [including relaxation]' and 'Socialising & Sense of Community')
- **Enjoyment benefits** (with further sub-categories of 'Enjoying the Biodiversity & Beauty of the Marine Estate' and 'Consumptive Use [e.g. catching a fish]')
- **Cultural heritage & use benefits** (with sub-categories of 'Tangible Aboriginal Cultural Heritage [historic objects, places, items, and source of food]' and 'Intangible Aboriginal Heritage [traditions, practices, knowledge, spiritual values']).

Economic

- Benefits related to '**Indirect economic values'** which was further defined as 'Intrinsic & bequest values'
- Benefits related to employment and the value of production which was further defined as '**Viability of Businesses'**
- Benefits related to **'Direct economic values'** which was further defined as the 'Individual enjoyment value or consumer surplus' (e.g. an economic term for the difference between what a consumer or user is willing to pay for a benefit or services versus what they actually pay for a benefit or service).

2.4 Threats to Community Benefits

Threats to community benefits arise from a range of activities and resource uses of the marine estate or environmental, social and economic stressors.

The threat activities identified in the TARA matrices were grouped and categorised differently between the environmental and the social and economics assessments.

For the *environmental assessment* this included:

- Stressors to environmental assets arising from 'Resource Uses or Activities' including, for example, recreational fishing, commercial fishing, boating and other water uses and activities;
- Threats arising from 'Land Based Impacts' including, for example, urban stormwater discharge, beach nourishment and coastal development; and
- Threats arising from 'Climate Change', including, for example, sea level rise and ocean acidification.

For the *social and economic assessment*, many of the uses and activities that generate social and economic benefits also give rise to stressors to other uses and activities of the marine estate. Benefits can also be impacted by other stressors (environmental, public safety, MEMA regulation and access restrictions etc.). Recognising this, the threats identified for the social and economic TARA included:

- Threats from 'Resource Uses or Activities' on other 'Resource Uses or Activities' (such as commercial fishing, recreational activities, tourism activities and similar);
- Threats from 'Environmental Impacts' on 'Resource Uses or activities' (such as water pollution, depletion of fish stocks, coastal development and climate change);
- Threats associated with 'Health and Safety Impacts'; and
- Threats related to the effect of 'MEMA Regulations', which includes the effects of regulation on the flow of social and economic benefits, the effect of the restriction of access to the Marine Estate (or its resources) on the flow of social and economic benefits and constraints to benefits related to funding and support.

The common threat activities to both the environmental and social and economic assessments (which form the basis for the comparison of threats across the marine estate as a whole in the bioregion) are discussed further in Section 5 of this report.

It was also recognised as part of the TARA process that there are a range of external factors that can affect the level of use occurring in the marine estate. Nevertheless, it was agreed the primary focus of the TARA should be on:

- What MEMA can and does manage in the marine estate; and
- Threats to the *actual* flow of environmental, social and environmental benefits to the marine estate, but not how these benefits are actually used unless their level of use specifically relates to MEMA's management regulations.

Example issues that could affect how benefits are used but that are outside of control of MEMA (and therefore not considered explicitly in the TARA) include:

- Economic downturn;
- Increased fuel and other base costs;
- Rising fares;
- Market saturation; and
- Reduced land availability for settlement.

2.5 Evidence Based Approach

The TARA seeks to ensure all relevant and credible information sources are used to identify the risk of a threat being realised. This is recognised to include multiple sources of information, for example, scientific literature, scientist expert opinion, media, community and stakeholder views, etc.

Five information reports were developed to inform the TARA for the HSMB assessment:

- Community Engagement Information Report – MEMA (2015b) 'Background to the Hawkesbury Shelf Marine bioregion assessment Report 1 – community engagement'.
- Environmental Information Report – MEMA (2015c) 'Hawkesbury Shelf Marine Bioregion Assessment. Report 2 - Background environmental information'.
- Social and Economic Information Report – Vanderkooi Consulting (2015) 'Social and economic background information report on the NSW marine estate'.
- Aboriginal Cultural Heritage Information Report – Feary, S. (2015) Sea Countries of New South Wales: benefits and threats to Aboriginal people's connections with the marine estate.
- Schnierer, S. (2015) Peer Review of Draft Report "Sea countries of New South Wales: benefits and threats to Aboriginal people's connections to the marine environment" for the Marine Estate Expert Knowledge Panel. Suffolk Park, 7pp.

Much of the generic information on social, cultural and economic benefits and threats for the bioregion information reports were derived from the broader estate scale report, but this was supplemented where applicable by more geographically specific evidence.

In general, evidence presented as part of the TARA for the bioregion (as set out in full in Appendix C and Appendix D of this report) can be sourced from one or more of the following sources:

- The four background information reports prepared by the MEMA agencies and external consultants (outlined above);
- Additional information, research and academic papers identified by MEMA agencies and independent experts; or
- Expert opinion of subject matter experts – particularly in the context of the independent experts that participated in the workshops (refer Appendix B).

2.6 Spatial Scale

A key attribute of the TARA is that it should be scalable from statewide down to the geographic region that best aligns with the management issue being investigated.

For the HSMB assessment, the spatial extent of the risk of the threat to a benefit being realised was examined at a whole of bioregional scale (R) as well as at a local scale (L).

Local scale in this context included considering threats in particular estuaries, beaches, for localised fisheries or other similar features. Where the occurrence of the threat was occurring across multiple localities, this was considered in the risk score and documented as part of the evidence presented.

Despite being a bioregional scale assessment, it was agreed that a 'high' risk of impact at the local scale was important to capture as part of the TARA process. Future management considerations in the next phase of marine estate planning may recommend these more local issues do not need to be fully addressed by the HSMB assessment or Marine Estate Management Strategy and planning process but may be more adequately addressed through other planning initiative such as Coastal Zone Management Plans (and previous Estuary Management Plans).

Inversely, effective management of a potential statewide threat—such as water run-off and its impact on water quality in the NSW marine estate—could require a more detailed assessment of particular regional sources of water run-off, the associated contaminants, and their impacts on particular economic, social and environmental benefits in particular places.

2.7 Temporal Scale

The TARA seeks to identify when the risk of the threat being realised will commence (over time), and presents the following options within the 20 year planning horizon for the MEMA decision making process:

- Current or in the short term (1-2 years)
- In the medium term (10 years)
- In the longer term (20 years).

Participants in the workshop processes also agreed to include a timeframe of 50 years when considering the possible risks of threats from climate change being realised. This was based on the collective view that the risk profile for threats such as sea level rise and ocean acidification may be still be emerging in 20 years but become more severe and widespread when considering a 50 year time horizon, with a need to consider these longer term trajectories as part of current management.

2.8 Priority Risks for Treatment

Consistent with the 5-step decision making process, the TARA and its outputs are a tool for the prioritisation of risks for treatment that will be further assessed as part of the management options stage of marine planning for the HSMB.

In this context, assignment of a 'High' or 'Moderate' risk level is a trigger for further interrogation of the threat to an asset or benefit but will not necessarily lead to a change to current management or regulations.

MEMA will evaluate the assigned risks through a risk evaluation process with a view to determining appropriate tolerance levels and treatment options consistent with the TARA framework and adopted standards for risk management.

The risk evaluation will likely adopt an approach similar to the 'generic' risk tolerance table shown below in Table 2-3.

Table 2-3 Example of a Generic Risk Tolerance Table

Risk Levels	Description	Likely Management Action
Minimal	Risk acceptable; no further action proposed	Nil
Low	Risk acceptable; no further action proposed at current time but trend to be tracked over time	Monitoring of risk likelihood and consequence over time to identify if risk is increasing, decreasing or staying the same
Moderate	Risk may be acceptable with suitable risk control measures in place or additional action may need to be considered	Review of existing management controls or activities for the risk and increased or different management controls or activities may be needed.
High	Risk unlikely to be acceptable and further action should be proposed	Review of existing management controls or activities for the risk and increased or different management

The risks identified by MEMA agencies and the independent experts as described in this report are an initial assessment and are not 'cast in bronze'. They will very likely change over time with the presentation of additional evidence and following further engagement with the community and stakeholders of the marine estate.

That said, a key advantage of having completed this initial TARA approach for the HSMB will be the ability to re-visit the risk ratings and evidence over time. This process can be used to track and confirm the likelihood of the consequence of the risk occurring which can inform a more adaptive approach to management.

2.9 Level of Confidence in Risk Ratings

The initial TARA assessment for the bioregion (as outlined in this report) has drawn upon the best available information from a range of sources; with the aim of the process to identify priorities for further attention.

These are likely to include threats for which the relevant NSW management agencies need a more detailed application of the framework.

To convey the level of confidence in this knowledge in terms of assigning a risk rating, the following ratings were adopted for use in the TARA:

- Adequate (there is adequate high quality evidence in the bioregion) (A)
- Limited (there is limited evidence, for example, there may be limited evidence for the bioregion but evidence for other parts of the state) (L)
- Inferred (there is very limited evidence, for example, there may be limited evidence for the state, but evidence from elsewhere) (I).

Risk ratings that are highly inferred are considered key knowledge gaps for consideration in future stages of the process.

As outlined in TARA, while much of the information and evidence used is 'limited' or 'inferred', a more detailed risk assessment is needed only when the additional information will improve our understanding of the threat and what can be done to manage it.

2.10 Workshops

Further information about the workshop process and proceedings that underpins the TARA for the HSMB assessment is contained in Appendix B.

2.11 Limitations

While evidence based, it should be recognised that the TARA is a subjective process and the workshops undertaken as part of the current study for the Hawkesbury Bioregion were treated as a pilot for the methodology prior to its application to other bioregions and the overall state wide assessment.

There are a number of limitations that should be noted in reading or reviewing this report:

- The risk ratings and threat and benefit information have been derived directly from the advice and views of the MEMA agency staff and independent experts that participated in the workshops. The assigned risks and other information presented in the report do not necessarily represent the views of the authors of the report (BMT WBM as the independent risk assessment facilitator) or represent NSW Government policy.
- Instead, it should be recognised that the TARA and its outputs as outlined in this report are a tool for the prioritisation of risks that can then be assessed as part of the management options and response stage in Steps 3-4 of the MEMA decision making framework (see **Figure 1-1**).
- In this context, assignment of a 'High' or 'Moderate' risk level is a trigger for further interrogation of the threat to an asset or benefit but will not necessarily lead to a change to current management or regulations.
- Likewise, the risks identified in the report are not 'cast in bronze' and will very likely change over time with the presentation of additional evidence and further engagement with the community and stakeholder groups.
- The consideration of social and economic benefits alongside environmental assets is complex with many interrelated threats and benefits identified as part of the workshop process. As a

result, there are a range of inconsistencies that have been identified between the environmental and social and economic risk assessments that will need to be further discussed and resolved as part of subsequent assessments.

- Lastly, it should be noted that the risk assessment has been completed based on a perception of the effectiveness of the current regulations and management regimes for addressing the threats identified. This has inherent bias depending on who is undertaking the assessment (e.g. the regulator versus the person or entity being regulated) and is an issue that will be further examined as part of the risk evaluation and management options process following the TARA in Steps 3-4 of the MEMA decision making framework (see **Figure 1-1**).

3 Findings of the Environment Risk Assessment

3.1 Introduction

For the environmental assessment component of the TARA, a decision was made to split the Hawkesbury Shelf marine bioregion planning area between:

a) The 'coastline and marine waters' area - incorporating open coast beaches and foreshores, waters and marine benthic habitats and associated flora and fauna assemblages to the 3 nm limit of State jurisdiction; and

b) The 'estuarine' area - in this report estuaries are defined by a straight line across the two closest points on opposing headlands. Although this is an arbitrary separation in terms of marine ecological processes, it conveniently divides these two ecosystem types for the purpose of this threat and risk assessment.

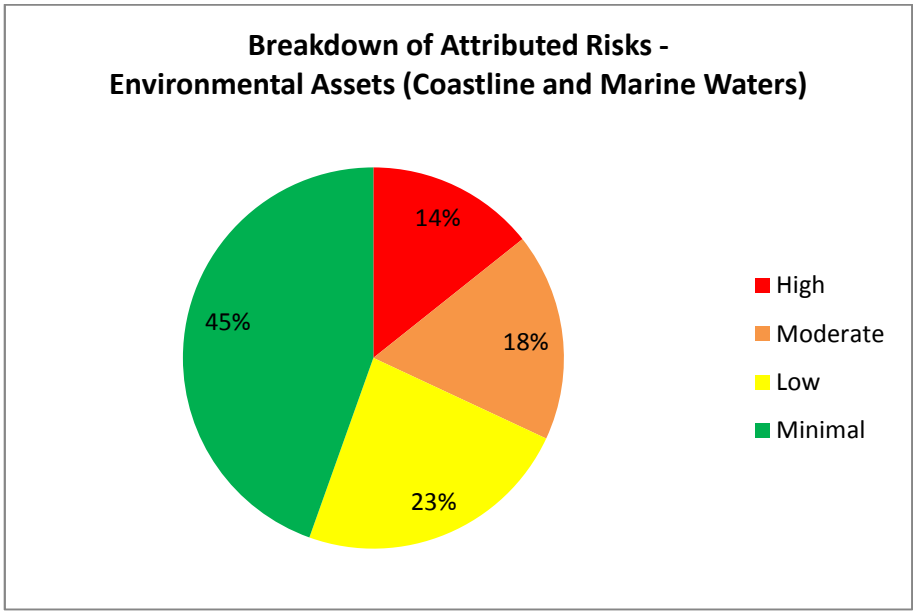
The fully completed coastline/marine and estuarine matrices for the environment component of the TARA are contained in Appendix C of this report. Appendix C also contains the full evidentiary justification for the risk ratings as compiled by the MEMA agencies and the independent experts.

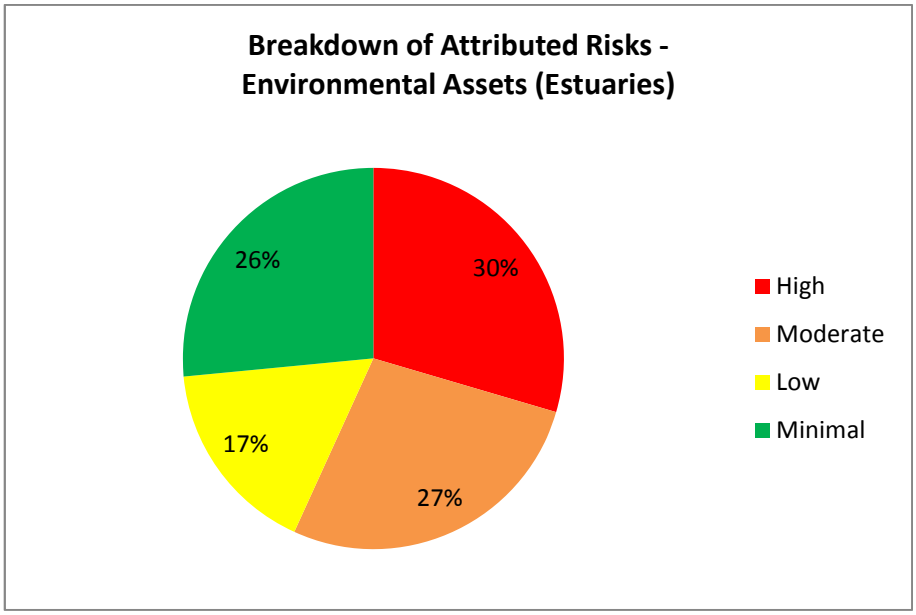
3.2 Summary of Key Risks – Environmental

3.2.1 High and Moderate Risks

In reviewing the outputs of the TARA undertaken for environmental assets in Appendix C, many of the risks to the threats being realised were 'Low' (denoted by yellow boxes) or 'Minimal' (denoted by green boxes). This was particularly the case for the coastline and marine areas compared to the estuaries which had a much greater proportion of 'Moderate' and 'High' risks.

The general distribution of risk ratings from the risk matrices for the coastline and marine waters and estuaries presented in Appendix C is shown in pie graphs below:





In the context of high and moderate risks, for the coastlines and marine waters of the bioregion, there were 17 instances where the risk of the threat being realised was rated as having a 'High' risk to environmental assets. There were 21 instances where the risk of the threat being realised was rated as having a 'Moderate' risk to environmental assets. These 'High' and 'Moderate' risks are summarised in Table 3-1 at the end of this chapter.

For the estuaries in the bioregion, there were 40 instances where the risk of the threat being realised was rated as having a 'High' risk to environmental assets. There were 36 instances where the risk of the threat being realised was rated as having a 'Moderate' risk to environmental assets. These 'High' and 'Moderate' risks are summarised in Table 3-2 at the end of this chapter.

The combined outputs of Table 3-1 and Table 3-2 therefore represent the key threats to environmental assets of the marine estate in the bioregion.

For both tables, the key evidence presented by workshop participants underpinning these risk ratings is summarised in the table, with more detailed information available in Appendix C.

Information collected about spatial scale, temporal scale, trend and level of confidence are also presented in the tables and are further discussed below.

3.2.2 Spatial Scale of Risks

In general terms, most threats from the identified uses, activities and stressors are operating at a broad spatial scale (e.g. across the whole bioregion or at many locations across the bioregion).

In general there are a much greater number of risks from threats to environmental assets in the estuaries compared to coastlines and marine waters and a proportionately larger number of 'High' and 'Moderate' risks in the estuaries compared to the coastline and offshore areas. This is largely a function of: (i) the greater levels of human use and occupation of estuaries; and (ii) their smaller size and reduced resilience to impact relative to the much larger offshore area which has lower levels of use and access beyond the ocean beaches and nearshore zone.

Activities where risks to benefits were identified as only operating at highly localised (e.g. sub-regional or site specific) scale included:

- Shipping (noting large vessels operate from the bioregion's four major ports);
- Recreational Fishing on the coastline and marine waters; and
- Commercial Fishing in the estuaries.

3.2.3 Temporal Aspects of Risks and Trends

In considering the temporal aspects of the risks, most risks are considered to be current issues happening now (e.g. at the present time) with the threat of the risk being realised expected to intensify or increase over time.

Commercial Fishing and Recreational Fishing were identified as activities where the risks to environmental assets may reduce over time due to decreased license uptake and use of the marine estate for this purpose. The threats from several other activities and uses were considered to be stable or uncertain over time (shown as **#** in the Table).

Various aspects of Climate Change (ocean acidification, sea level rise and others), were specifically noted by participants to be an issue that needed to be considered for management as part of the current planning process (in the context of understanding vulnerability and building resilience to future impacts). However, it was also noted that the timing of threat realisation will be in the 20+ year category, with the extent and severity impacts only able to be inferred at the current time.

3.2.4 Priority Risks for Treatment

In looking at those resource uses, activities and issues that had an incidence of high or moderate risks to an environmental asset provided by the marine estate, a hierarchical list of these priority risks has been generated based on the number of high versus moderate risks and collected information about the risk trends (e.g. activities where the risks were increasing were given the

highest priority, followed by risks that were stable and then risks that were decreasing). Based on this broad analysis of the data, activities and issues generating the greatest threat to environmental assets of the bioregion (in descending order) were:

- Climate change (50 year timeframe)
- Urban stormwater discharge
- Clearing, dredging & excavation activities
- Shipping
- Recreation & tourism
- Recreational boating & boating infrastructure
- Foreshore development
- Agriculture diffuse source runoff
- Point discharges
- Estuary opening/modified freshwater flows
- Recreational fishing
- Commercial fishing
- Aquaculture
- Charter fishing
- Charter activities

3.2.5 Key Knowledge Gaps

As identified in Table 3-1 and Table 3-2, there are only two uses/activities (coastal development and shipping in estuaries) where participants felt there was 'adequate' confidence in the knowledge base from which to assign the risk ratings to the environmental benefits. The majority of ratings were based on information sources that were judged as 'limited'.

The least confident ratings (e.g. inferred) were assigned as follows:

For the coastline and marine waters:

- Shipping
- Climate Change

For estuaries:

- Recreation and Tourism
- Climate Change

Further information about how threats from these uses, activities and stressors affect environmental assets and the environmental benefits that accrue from those assets represent key knowledge gaps for consideration in the next phase of MEMA planning.

Table 3-1 Risks to Environmental Assets for Coastline and Marine Areas

Use, Activity or Stressor	Environmental assets along the Coastline and in Marine Areas that are at 'High' risk from the use/activity/stressor	Environmental Assets of the Coastline and in Marine Areas that are at 'Moderate' risk from the use/activity/stressor	Summary of Evidence	Spatial Extent of Risks	Temporal and Risk Trend	Confidence
Shipping and Commercial Vessels (includes Large and Small Commercial Vessels)	• Deep Soft Sediments • Species Protected under TSC Act	• Deep Reefs	• Most ships anchor outside 3nm however, anchor chains drag inside 3nm impacting deep soft-sediment habitat, deep rocky reef habitat and associated biota • Vessel strike, noise and wildlife disturbance and subsequent changes in wildlife behaviour. Data show 10 year history of interactions. • Marine Debris • Possible spills	Localised	Current issue (now) Large vessels - Trending ↑ Small vessels – Trending # (stable)	Inferred
Commercial Fishing (includes Ocean Trap and Line, Ocean Trawl, Ocean Haul, Sea urchin and turban shells, Lobster, Abalone)	• Nil	• Pelagic Assemblages • Shallow Reefs • Species Protected under FMA • Species Protected under TSC Act • Deep Soft Sediments	• Ocean trawl gear type used can result in measurable impacts on benthic biota and result in moderate levels of bycatch • Sea Urchin and turban shells have life history characteristics that result in mod-low resilience. • Impacts on pelagic assemblages as a result of the ocean haul fishery e.g. targeting by purse-seiners of sweep from Wollongong resulted in localised depletions • Ocean trap and line catch and ocean trawl effort occur in coastal waters in the bioregion, and observer work identified some interaction with white sharks, grey nurse sharks or black cod in coastal waters. • Large whale entanglements / seabird take on long lines • Intentional harm to seals • Disturbance of birds by beach activities.	Regional	Current issue (now) Trending ↓	Limited
Recreational Fishing (includes Shore-based line and trap fishing, Boat-based line and trap fishing, Spearfishing, Hand Gathering)	• Species Protected under TSC Act	• Shallow Reefs • Rocky Shores • Species Protected under FMA	• Harvest bycatch, • Marine debris • Damage from anchors • 4WD impacts from physical compaction and disturbance (e.g. pipis, beachworms) • Hand Collection (and trampling) • Seabird entanglements • Turtles caught in crab pots • Entangled seals / Seals caught in lures reported to NPWS	Localised	Current issue (now) Trending ↓	Limited
Recreational Boating	• Nil	• Species Protected under TSC Act	• Vessel Strike on Turtles and Penguins	Regional	Current issue (now) Trending # (stable)	Limited
Recreation and Tourism (includes snorkelling and diving, 4WD, swimming and surfing, shark meshing of beaches and charter activities)	• Beaches • Species Protected under TSC Act • Species Protected under FMA	• Nil	• 4WD on beaches impacting nesting and foraging of shorebirds / nesting of turtles • Whale tourism impacts (noise, disturbance, displacement, stress, behavioural change • Shark meshing known to catch white sharks, grey nurse sharks and now identified as a Key Threatening Process • Shark meshing associated with entanglement of cetaceans and turtles	Regional	Current issue (now) Trending ↑	Limited
Foreshore / urban development (includes beach nourishment and grooming)	• Beaches • Species Protected under TSC Act	• Rocky Shores	• Foreshore development completely alters habitat (including loss of nearshore habitat for shorebirds and turtles) • Nourishment and grooming of beach can alter / remove habitat characteristics, impacting biota and processes	Regional	Current issue (now) Trending ↑	Limited

Use, Activity or Stressor	Environmental assets along the Coastline and in Marine Areas that are at 'High' risk from the use/activity/stressor	Environmental Assets of the Coastline and in Marine Areas that are at 'Moderate' risk from the use/activity/stressor	Summary of Evidence	Spatial Extent of Risks	Temporal and Risk Trend	Confidence
			• Some aspect are a legacy issues -new foreshore development on rocky shores is unlikely to occur with current management settings e.g. zonings, SEPP 71, CZMPs etc.			
Water pollution and sediment contamination (includes urban stormwater, agricultural runoff, industrial discharges, sewage effluent)	• Species Protected under TSC Act	• Beaches • Rocky Shores • Shallow Reefs • Deep Reefs • Pelagic Assemblages	• Contaminants in urban stormwater have been shown to alter biota, microbial assemblages and can result in local production of nuisance microalgae • Evidence of micro-plastics, marine debris and other contaminants impacting marine turtles and dolphins • Localised impact of sewage discharge on rocky shore and assemblages surrounding discharge area	Regional	Current issue (now) Trending ↑	Limited
Clearing, dredging and excavation activities (includes vegetation clearing, dredging, service infrastructure, mining and extraction)	• Species Protected under TSC Act	• Beaches • Deep Soft Sediments	• Loss of habitat for shorebirds likely to lead to local extinctions / declines to threatened species. • Physical disturbance, sediment resuspension and re-distribution (incl. contaminated sediments) associated with dredging impacting habitat and biota • Loss of coastal vegetation is a legacy issue	Regional	Current issue (now) Trending ↑	Limited
Estuary openings/modified freshwater flows (includes hydrological modifications/estuary entrance/modified freshwater flows)	• Beaches	• Nil	• Dredging, mechanical openings, construction of walls change natural habitat characteristics and sand movement	Regional	Current issue (now) Trending ↑	Limited
Climate Change (based on a 50 year projection of impacts)[1]	• Ocean Waters • Beaches • Shallow and Soft Sediments • Deep Soft Sediments • Pelagic Assemblages • Species Protected under TSC Act	• Rocky Shores • Shallow Reefs • Deep Reefs	• Acidification impacts for calcifying organisms and sensitive organisms (urchins, molluscs, colicophores, pteropods) • Larger pH changes may affect sensitive organisms such as echinoderms and molluscs, • Beaches lost where capacity to extend inland is limited, impacts for foraging shorebirds • Changes in primary production due to changed currents & nutrient inputs • Changes to East Australia Current and temperatures likely to impact migration of turtles, whales and dolphins • Changes to nutrients and fish abundance likely to impact higher order predators (seabirds, marine mammals, turtles) • Changes in temperature likely to impact turtles nesting success and sex composition • Dynamics of coastal wetlands likely to change, impacting shorebirds • Increased mortality of marine fauns after extreme events • Limited capacity for biota to move in most places. Shore platforms particularly vulnerable to modest increases in sea level, leading to displacement of habitat and biota	Regional	Some risks now but likely consequence in next 20 years Trending ↑	Inferred

[1] The 20 year planning horizon for climate change in the coastline/marine area included 'High' Risks specifically for Sea Level Rise on Species Protected under the TSA and 'Moderate' Risks for Beaches, Deep Reefs, Pelagic Assemblages and Species Protected under the TSA for other climate change stressors – refer Appendix C for further information.

Table 3-2 Risks to Environmental Assets for the Estuary Areas

Use, Activity or Stressor	Environmental Assets in Estuaries that are at 'High' risk from the use/activity/stressor	Environmental Assets in Estuaries that are at 'Moderate' risk from the use/activity/stressor	Summary of Evidence	Spatial Extent of Risks	Temporal and Risk Trend	Confidence
Shipping (includes Large and Small Commercial Vessels)	• Mangrove • Species Protected under TSC Act	• Estuarine waters • Saltmarsh • Beach and Mudflats • Shallow and Soft Sediments • Rocky Shores • Species and Populations Protected under FMA	• Antifouling paint can pollute water ways • Vessels as vectors of pests and disease • Oil spills (very high consequence) • Rivercat impacts in the Parramatta River such as sediment resuspension and community composition change from vessel wake.	Localised	Current issue (now) Trending ↑	Adequate
Commercial Fishing (includes Estuary General and Estuary Prawn Trawl)	• Nil	• Species Protected under TSC Act • Pelagic Assemblages • Shallow and Soft Sediments	• Related to impacts on *Posidonia* and associated protected species (e.g. sygnathids) • Impacts on TSC - inferred from seabirds and dolphins in SA • Impact on habitat and associated biota as a result of the estuary prawn trawl fishery on shallow soft sediments (e.g. harvest, by-catch, physical disturbance) • Impact on pelagic assemblages as a result of estuary general fishery and estuary prawn trawl (e.g. harvest, by-catch) against background variations, and moderate resilience characteristics of many species. • Entanglement of shorebirds, marine mammals, turtles	Localised	Current issue (now) Trending ↓	Limited
Recreational Fishing (includes Shore-based line and trap fishing, Boat-based line and trap fishing, Spearfishing, Hand Gathering, Fish stocking)	• Species Protected under TSC Act	• Subtidal Reefs • Pelagic Assemblages • Shallow and Soft Sediments	• High mortalities of turtles from fish traps and crab pots • Seals caught in lures • Marine debris • Harvest • Bycatch • Highly concentrated within Hawkesbury Shelf Marine Bioregion	Regional	Current issue (now) Trending ↓	Limited
Boating and Boating Infrastructure	• Seagrass • Beach and Mudflats • Shallow and Soft Sediments • Species and Populations Protected under FMA	• Estuarine Waters • Rocky Shores • Subtidal Reefs • Pelagic Assemblages • Species Protected under TSC Act	• Copper pollution - significantly elevated concentrations in organisms from areas with high concentrations of moored boats. • Physical disturbance, propeller / anchoring / mooring combined with low resilience of components of the habitat to these impacts (i.e. *Posidonia seagrass population*). • Sediment resuspension – light limitation • Shading from boats and jetties • Bank erosion linked to wakeboarding in upper estuary areas • Soft corals and sponges not mapped but thought to be highly susceptible • Vessel strike, disturbance from boats, feeding of seabirds	Regional	Current issue (now) Trending ↑	Limited
Recreation and Tourism (includes snorkelling and diving, 4WD, swimming and surfing, and charter activities)	• Species Protected under the TSC Act & Species and Populations Protected under FMA	• Saltmarsh • Beach and Mudflats	• 4WD damage to saltmarsh • General wildlife disturbance • Seabird entanglement from charter fishing	Regional	Current issue (now) Trending ↑	Inferred
Foreshore / urban development (includes beach nourishment and grooming)	• Beach and mudflats • Shallow and soft sediments • Species Protected under TSC Act	• Seagrass • Mangrove • Saltmarsh • Rocky shores	• Foreshore development physically destroys habitats and biota, • Changed wave patterns damage habitat and alter grain size • Impacts high on nesting shorebirds and turtles from permanent loss of near shore habitat	Regional	Current issue (now) Trending ↑	Adequate

Use, Activity or Stressor	Environmental Assets in Estuaries that are at 'High' risk from the use/activity/stressor	Environmental Assets in Estuaries that are at 'Moderate' risk from the use/activity/stressor	Summary of Evidence	Spatial Extent of Risks	Temporal and Risk Trend	Confidence
		• Species and Populations Protected under FMA	• Direct habitat disturbance or removal • Impacts to seagrass through physical damage, change in light • Removal of wrack sometimes damages living seagrass beds.			
Water pollution and sediment contamination (includes urban stormwater, agricultural runoff, industrial discharges, sewage effluent and thermal discharges)	• Estuarine Waters • Saltmarsh • Seagrass • Beach and Mudflats • Shallow and soft sediments • Subtidal Reefs • Pelagic Assemblages • Species and Populations Protected under FMA • Species Protected under TSC Act	• Mangroves • Rocky Shores	• Stormwater transports bioavailable nutrients, toxins (heavy metals), suspended sediments and marine debris • Agricultural runoff transports sediments, nutrients and potentially agricultural chemicals • Industrial runoff transports nutrients, contaminants and enriched sediments • These contaminates impact seagrass diversity and abundance and disrupt other ecological processes	Regional	Current issue (now) Trending ↑	Limited
Clearing, dredging and excavation activities (includes vegetation clearing, dredging, service infrastructure, mining and extraction)	• Estuarine Waters • Saltmarsh • Shallow and soft sediments • Species and Populations Protected under FMA • Species Protected under TSC Act	• Mangroves • Seagrass • Beach and Mudflats • Pelagic Assemblages	• Black water events after floods • Altering water tables and connectivity • Loss of habitat for migratory shorebirds	Regional	Current issue (now) Trending # (stable)	Limited
Estuary openings/modified freshwater flows (includes Hydrological modifications/estuary entrance/modified freshwater flows)	• Saltmarsh • Mangrove • Seagrass • Species and Populations Protected under FMA	• Estuarine Waters • Beach and Mudflats • Shallow and soft sediments • Pelagic Assemblages • Species Protected under TSC Act	• Changed water table and inundation regimes results in very broad overall impacts. • Changes result in mangrove encroachment on other habitat (e.g. saltmarsh) • Changes in tidal dynamics alter salinity regimes and current dynamics and impacts seagrass. • Modified freshwater flows result in impacts /ASS leaching	Regional	Current issue (now) Trending ↑	Limited
Climate Change (based on a 50 year projection of impacts)[2]	• Saltmarsh • Mangrove • Seagrass • Beach and Mudflats • Shallow and Soft Sediments • Rocky Shores • Subtidal Reefs • Pelagic Assemblages • Species and Populations Protected under FMA • Species Protected under TSC Act	• Estuarine Waters	• For saltmarsh experimental studies show response and expected change is greater than thresholds • Experimental studies show acidification an issue for saltmarsh, molluscs (and other calcifying organisms), seagrass (and associated organisms). • Seagrass (*Zostera*) is sensitive to decreased salinity, increased wave action and increased turbidity • Loss of habitat and nesting sites for shorebirds and turtles. Loss of shorebirds foraging habitat. Loss of intertidal foraging habitat including seagrass.	Regional	Some risks now but likely consequence in next 20 years Trending ↑	Inferred

[2] The 20 year planning horizon for climate change in the estuaries included 'High' Risks specifically for Sea Level Rise on Saltmarsh, Species Protected under the FMA and Species Protected under the TSA and 'Moderate' Risks for Mangroves, Pelagic Assemblages and Species Protected under the TSA for other climate change stressors – refer Appendix C for further information.

4 Findings of the Social and Economic Risk Assessment

4.1 Introduction

For the social and economic component of the TARA, a decision was made to split the uses and activities of the marine estate in the bioregion into 17 mutually exclusive categories as described in Section 2.3. Each of these 17 activity categories was then assessed in the context of what social and economic benefits are provided (or derived) by the use or activity and the risks to those benefits based on a common list of threats.

The fully completed TARA matrices for the social and economic uses and activities are contained in Appendix D of this report. Appendix D also contains the evidentiary justification for scores as compiled by MEMA agencies and the independent experts.

As part of the workshop, a decision was taken by participants to not complete the risk matrix developed for the use entitled, 'Retail and Trade' on the basis that the largely indirect and secondary social and economic benefits accruing from the marine estate to this sector were either being captured as part of the other categories (e.g. consideration as part of the 'Viability of Businesses' category in matrices such as 'Tourism & Accommodation') or otherwise were difficult to characterise in terms of their relative dependency to marine estate values.

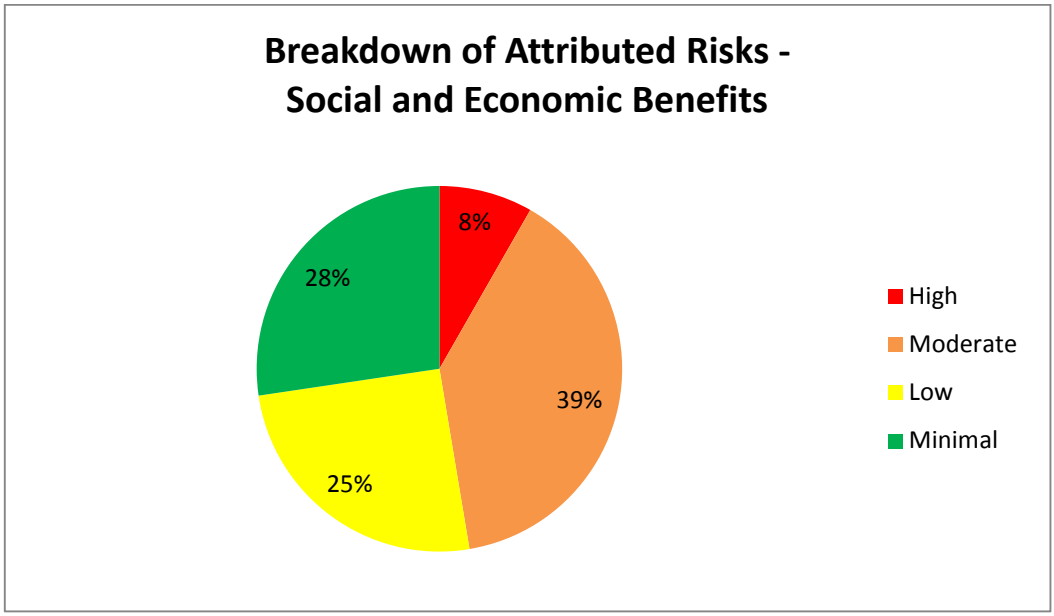
The use of the marine estate for 'Extractive Industries' has a low level of current use due to the effect of current regulations on this sector, but noting it may become a more salient issue within the 20 year timeframe of MEMA planning. In this context, threats that could adversely affect the use of the marine estate for extraction and mining were also identified for future consideration as part of the TARA but without allocating a risk rating.

4.2 Summary of Key Risks – Social and Economic

4.2.1 High and Moderate Risks

In reviewing the outputs of the TARA undertaken for social and economic benefits in Appendix D, there were a higher proportion of 'Moderate' risks compared to 'High' and 'Low' risks for the social and economic benefits.

The general distribution of risk ratings from the risk matrices presented in Appendix D is shown in pie graph below:



In the context of high and moderate risks, there were:

- 60 instances where the risk of the threat being realised was identified as a 'High' risk;
- 283 instances where the risk of the threat being realised was identified as a 'Moderate' risk.

All of the high and moderate risks are summarised in Table 4-1, noting the uses, activities and stressors listed in this table often pose a risk to more than one activity category – for example, the threat of 'Water Pollution and Sediment Contamination' effects the economic benefits derived from 'Aquaculture' as a 'High' risk as well as the social and economic benefits derived from Commercial Fishing, Recreational Fishing, Conserving Environment & Heritage and Recreation as a 'Moderate' risk.

In this context, it is important to note the evidence presented for the risk rating in Table 4-1. Many of the risks identified in the social and economic assessment were indicative of a use conflict between uses of the marine estate (such as between Recreational Fishing and Commercial Fishing) or even within an use category (such as overcrowding and antisocial behaviour within the Recreational Fishing sector) as opposed to the overall threat to the existence of the use or activity as a whole or the benefits that the community derives from the use or activity.

More comprehensive information about the risks and evidence can be sourced from Appendix D. Information collected during the workshop about spatial scale, temporal scale, trend and level of confidence is also presented in Table 4-1 and discussed below.

4.2.2 Spatial Scale of Risks

In general terms, all of the key risks (identified in the previous section) to social and economic benefits were observed by participants to be operating at a broad spatial scale (e.g. occurring throughout the bioregion).

Cultural Fishing was the only activity identified by participants in the workshop as having risks that were considered much more localised within the HSMB based on the evidence provided.

4.2.3 Temporal Aspects of Risks and Trends

In considering the temporal aspects of the risks identified, most are considered to be current issues happening now (e.g. at the present time) with the threat of the risk being realised expected to intensify or increase over time.

The risks to social and economic benefits from Commercial Fishing and Cultural Fishing were identified as risks that may reduce over time due to decreased effort and use of the marine estate for this purpose. Several other uses and activities were considered to be stable or uncertain over time (shown as **#** in the Table).

As with the environmental assessment, various aspects of climate change (ocean acidification, sea level rise and others) were specifically noted by participants to be an issue that needed to be considered for management as part of the current planning process (in the context of understanding vulnerability and building resilience to future impacts), but also noting the timing of threat realisation will be in the 20+ year category, with the extent and severity impacts only able to be inferred at the current time. A 50 year timeframe was adopted for assessing climate change risk.

4.2.4 Priority Risks for Treatment

In looking at those resource uses, activities and issues that had an incidence of high or moderate risks to a social or economic benefit provided by the marine estate, a hierarchical list of these priority risks has been generated based on the number of high versus moderate risks and collected information about the risk trends (e.g. activities where the risks was increasing were given the highest priority, followed by risks that were stable then risks that were decreasing). Based on this broad analysis of the data, activities and issues generating the greatest threat to social and economic benefits of the bioregion (in descending order) were:

- Effect of Regulation
- Access Availability
- Climate Change (50 year time frame)
- Recreational Fishing
- Commercial Fishing
- Sediment Contamination / Water Pollution
- Recreation and Tourism
- Foreshore Urban Development
- Reductions in abundancies of top and lower order trophic levels (depletion of fish stocks)
- Habitat Disturbance (loss of fish habitat)
- Pests and Disease
- Recreational Boating
- Funding

- Health and Safety
- Cultural Fishing
- Aquaculture
- Modified Freshwater flows / Estuary entrance management
- Shipping
- Adverse Wildlife Interaction

4.2.5 Key Knowledge Gaps

As identified in Table 4-1, there are only several uses, activities or stressors where participants felt there was 'adequate' confidence in the knowledge base from which to assign the risk ratings to the social and economic benefits for each use/activity. The majority of ratings were based on information sources that were judged as 'limited'.

The least confident ratings (e.g. inferred) were assigned to the following categories:

- Effect of 'Climate Change' on social and economic benefits of the marine estate
- Effect of 'Health and Safety' considerations on social and economic benefits of the marine estate

Risk ratings related to the 'Effect of Regulation', 'Restriction of Access' and 'Funding and Support' were also considered by the participants to be highly inferred; but noting that these issues will be further evaluated as part of the next phase of marine planning when assessing management options for identified risks.

Table 4-1 Risks to Social and Economic Benefits Provided by the Marine Estate in the Bioregion

Use, Activity or Stressor	Social and Economic benefits of the marine estate that are at 'High' risk from the use/activity/stressor	Social and Economic benefits of the marine estate that are at 'Moderate' risk from the use/activity/stressor	Summary of Evidence	Spatial Extent of Risks	Temporal and Risk Trend	Confidence
Shipping	Nil	• **Intangible Aboriginal Heritage** associated with *Conservation of Environment & Heritage* • **Viability of Businesses** associated with *Research & Education*, and *Ports & Shipping*.	• Environmental degradation reducing tourism potential • Inadequate recognition of Aboriginal connection to sea country • Environmental degradation reducing availability of control sites for research • Congestion / increased ship numbers and size affecting port operations	Regional	Current issue (now) Trending ↑	Limited
Commercial Fishing	• **Safety, Health & Wellbeing** of *Commercial Fishing* • **Socialising & Sense of Community** of *Recreational Fishing and Commercial Fishing,* • **Consumptive Use** associated with *Recreational Fishing* and *Research & Education* • **Intangible Aboriginal Heritage** associated with *Conserving Environment & Heritage* • **Indirect Economic Values** of *Recreational Fishing* • **Viability of Businesses** for *Commercial Fishing*	• **Safety, Health & Wellbeing** of *Recreational Fishing, Cultural Fishing, Aquaculture* and *Conservation of Environment & Heritage.* • **Socialising & Sense of Community** of *Cultural Fishing, Aquaculture, Conservation of Environment & Heritage* and *Maritime Related Activities*. • **Enjoying the Biodiversity & Beauty of the Marine Estate** of *Recreational Fishing, Cultural Fishing* and *Conservation of Environment & Heritage.* • **Consumptive Use** of *Cultural Fishing* and *Conservation of Environment & Heritage*. • **Intangible Aboriginal Heritage** of *Cultural Fishing* • **Tangible Aboriginal Cultural Heritage** of *Cultural Fishing* • **Direct Values** of *Recreational Fishing* • **Viability of Businesses** of *Aquaculture, Research & Education, Maritime Related Activities* and *Conservation of Environment & Heritage*. • **Indirect Values** of *Commercial Fishing*	• Conflict within Commercial Fishing industry • Loss of social licence • Equity issues between recreational and commercial fishers • Non-Indigenous use and management inadequate accommodation of Aboriginal connections to Sea country. • Congestion • Conflict over resource use and allocation / diminishing resources • Loss of undisturbed' control sites required for scientific research	Regional	Current issue (now) Trending ↓	Adequate
Cultural Fishing	• **Consumptive Use** associated with *Research & Education*	• **Safety, Health & Wellbeing** associated with *Conservation of Environment & Heritage* • **Socialising & Sense of Community** associated with *Conservation of Environment & Heritage* • **Enjoying the Biodiversity & Beauty of the Marine Estate** associated with *Conservation of Environment & Heritage* • **Consumptive Use** of *Recreational Fishing, Commercial Fishing* and *Conservation of Environment & Heritage.* • **Indirect Values** associated with *Conservation of Environment & Heritage* • **Viability of Businesses** of *Commercial Fishing, Research & Education* and *Conservation of Environment & Heritage*.	• Loss of undisturbed' control sites required for scientific research (not mitigated through marine parks in this bioregion) • Harvest of fish across recreational, commercial, cultural and illegal sectors is widely considered a threat to marine biodiversity and social benefits to conservation and passive users • Conflict over resource use and allocation / diminishing resources	Localised	Current issue (now) Trending ↓	Adequate

Use, Activity or Stressor	Social and Economic benefits of the marine estate that are at 'High' risk from the use/activity/stressor	Social and Economic benefits of the marine estate that are at 'Moderate' risk from the use/activity/stressor	Summary of Evidence	Spatial Extent of Risks	Temporal and Risk Trend	Confidence
Recreational Fishing	• **Safety, Health & Wellbeing** of *Commercial Fishing* • **Socialising & Sense of Community** of *Commercial Fishing* • **Consumptive Use** of *Commercial Fishing and Research & Education*. • **Intangible Aboriginal Heritage** associated with *Conservation of Environment & Heritage.*	• **Safety, Health & Wellbeing** associated with *Recreation, Recreational Fishing, Cultural Fishing, Aquaculture* and *Conservation of Environment & Heritage*. • **Socialising & Sense of Community** associated with *Recreation, Recreational Fishing, Cultural Fishing, Aquaculture, Conservation of Environment & Heritage* and *Maritime Related Activities*. • **Enjoying the Biodiversity & Beauty of the Marine Estate** associated with *Recreation, Recreational Fishing, Cultural Fishing, Commercial Fishing* and *Conservation of Environment & Heritage.* • **Consumptive Use** associated with *Recreation, Recreational Fishing, Cultural Fishing* and *Conservation of Environment & Heritage.* • **Tangible Aboriginal Cultural Heritage** associated with *Recreation* and *Cultural Fishing.* • **Intangible Aboriginal Heritage** associated with *Recreation* and *Cultural Fishing*. • **Indirect Values** of *Recreation, Recreational Fishing* and *Commercial Fishing* • **Viability of Businesses** of *Commercial Fishing, Aquaculture* and *Conservation of Environment & Heritage.* • **Direct Values** for *Recreation* and *Recreational Fishing*	• Conflict over resource use and allocation / diminishing resources / increasing population • Recreational fishers lobbying for commercial fishing closures • Loss of undisturbed' control sites required for scientific research (not mitigated through marine parks in this bioregion) • Inadequate recognition of Aboriginal connection to sea country / degradation of heritage sites • Loss of heritage values of the commercial fishing industry	Regional	Current issue (now) Trending ↓	Adequate
Recreational Boating	• **Consumptive Use** associated with *Research & Education* • **Intangible Aboriginal Heritage** associated with *Conservation of Environment & Heritage*	• **Safety, Health & Wellbeing** associated with *Recreation* and *Aquaculture.* • **Socialising & Sense of Community** associated with *Recreation* and *Aquaculture.* • **Enjoying the Biodiversity & Beauty of the Marine Estate** for *Recreation* • **Consumptive Use** associated with *Recreation* • **Tangible Aboriginal Cultural Heritage** associated with *Recreation* • **Intangible Aboriginal Heritage** associated with *Recreation* • **Viability of Businesses** of *Aquaculture* and *Research and Education* • **Indirect Values** associated with *Recreation* • **Direct Values** associated with *Recreation*	• Loss of undisturbed' control sites required for scientific research (not mitigated through marine parks in this bioregion) • Degradation of heritage sites and totemic species • Conflict over coastal area uses threatens the full range of social and economic benefits • Social acceptability problems with aquaculture development in foreshore areas • Oyster theft	Regional	Current issue (now) Trending ↑	Adequate
Recreation and tourism (including snorkelling and diving, swimming and surfing, 4WD)	• **Intangible Aboriginal Heritage** associated with *Conservation of Environment & Heritage*.	• **Safety, Health & Wellbeing** associated with *Recreation, Aquaculture*, and *Tourism & Accommodation*. • **Socialising & Sense of Community** associated with *Recreation, Aquaculture, Conservation of Environment & Heritage* and *Tourism & Accommodation*. • **Enjoying the Biodiversity & Beauty of the Marine Estate** associated with *Recreation, Conservation of Environment & Heritage* and *Tourism & Accommodation*.	• Impacts on cultural heritage sites from recreational activities and shoreline visitors (e.g. 4WD on beaches, anchors on wrecks, looting of wrecks by divers) • Anti-social behaviour, overcrowding and competing uses • Oyster theft is an on-going issue for all oyster growing areas.	Regional	Current issue (now) Trending ↑	Limited

Use, Activity or Stressor	Social and Economic benefits of the marine estate that are at 'High' risk from the use/activity/stressor	Social and Economic benefits of the marine estate that are at 'Moderate' risk from the use/activity/stressor	Summary of Evidence	Spatial Extent of Risks	Temporal and Risk Trend	Confidence
		• **Consumptive Use** associated with *Recreation, Research & Education, Conservation of Environment & Heritage* and *Tourism & Accommodation*. • **Tangible Aboriginal Cultural Heritage** for *Recreation* • **Intangible Aboriginal Heritage** for *Recreation* • **Indirect Values** associated with and *Tourism & Accommodation.* • **Viability of Businesses** of *Aquaculture*, and *Tourism & Accommodation.* • **Direct Values** for *Recreation*	• Non-Indigenous use and management that fails to accommodate Aboriginal connections to Sea country			
Aquaculture	• **Consumptive Use** associated with *Research & Education* • **Intangible Aboriginal Heritage** associated with *Conservation of Environment & Heritage*	• **Indirect Values** of *Cultural Fishing* • **Viability of Businesses** of *Cultural Fishing*, and *Research & Education* • **Direct Values** of *Cultural Fishing*	• Loss of undisturbed' control sites required for scientific research (not mitigated through marine parks in this bioregion) • non-Indigenous use and management that fails to accommodate Aboriginal connections to Sea country • Note some disagreement in evidence regarding opportunities for Indigenous participation in aquaculture	Regional	Current issue (now) Trending ↓	Limited
Foreshore / urban Development	• **Intangible Aboriginal Heritage** of *Cultural Fishing* and *Conservation of Environment & Heritage*. • **Consumptive Use** associated with *Research & Education*	• **Safety, Health & Wellbeing** associated with *Recreation, Aquaculture, Tourism & Accommodation* and *Conservation of Environment & Heritage*. • **Socialising & Sense of Community** associated with *Recreation, Aquaculture, Tourism & Accommodation* and *Conservation of Environment & Heritage*. • **Enjoying the Biodiversity & Beauty of the Marine Estate** associated with *Recreation, Tourism & Accommodation* and *Conservation of Environment & Heritage.* • **Consumptive Use** associated with *Recreation, Tourism & Accommodation* and *Conservation of Environment & Heritage*. • **Tangible Aboriginal Cultural Heritage** associated with *Recreation, Cultural Fishing* and *Conservation of Environment & Heritage*. • **Intangible Aboriginal Heritage** for *Recreation* • **Indirect Values** associated with *Recreation, Tourism & Accommodation* and *Conservation of Environment & Heritage*. • **Viability of Businesses** of *Aquaculture, Research & Education, Tourism & Accommodation* and *Ports & Shipping*. • **Direct Values** for *Recreation*	• Destruction of tangible Aboriginal cultural heritage. • Loss of undisturbed' control sites required for scientific research (not mitigated through marine parks in this bioregion) • Social acceptability problems with aquaculture development in foreshore areas. • Loss of cultural landscapes • Privatisation of the foreshore; legacy issues; seawalls an issue for the future • Crown Lands Review, potential divestment and redevelopment of Coastal open space • Loss of traditional fishing village character with redevelopment	Regional	Current issue (now) Trending ↑	Limited
Water pollution and sediment contamination	• **Safety, Health & Wellbeing** of *Aquaculture* • **Consumptive Use** of *Aquaculture, Research & Education*.	• **Safety, Health & Wellbeing** associated with *Recreation, Recreational Fishing, Commercial Fishing, Conservation of Environment & Heritage* and *Commercial & Charter Boating* • **Socialising & Sense of Community** associated with *Recreation,*	• Aquaculture production, employment and the quality and reputation of seafood is seriously affected by water quality in the Hawkesbury Bioregion	Regional	Current issue (now) Trending ↑	Limited

Use, Activity or Stressor	Social and Economic benefits of the marine estate that are at 'High' risk from the use/activity/stressor	Social and Economic benefits of the marine estate that are at 'Moderate' risk from the use/activity/stressor	Summary of Evidence	Spatial Extent of Risks	Temporal and Risk Trend	Confidence
	• **Viability of Businesses** of *Aquaculture*	*Recreational Fishing, Commercial Fishing* and *Conservation of Environment & Heritage*. • **Enjoying the Biodiversity & Beauty of the Marine Estate** associated with *Recreation, Recreational Fishing, Commercial Fishing, Conservation of Environment & Heritage* and *Commercial & Charter Boating* • **Consumptive Use** associated with *Recreation, Recreational Fishing, Commercial Fishing* and *Commercial & Charter Boating*. • **Tangible Aboriginal Cultural Heritage** for *Recreation* • **Intangible Aboriginal Heritage** associated with *Recreation* • **Indirect Values** associated with *Recreation, Recreational Fishing, Commercial Fishing* and *Conservation of Environment & Heritage*. • **Direct Values** associated with *Recreation, Recreational Fishing* and *Conservation of Environment & Heritage*. • **Viability of Businesses** of *Commercial Fishing, Conservation of Environment & Heritage* and *Commercial & Charter Boating*	• Loss of undisturbed control sites required for scientific research (not mitigated through marine parks in this bioregion) • Beaches are often temporarily closed or notifications given by Councils to avoid swimming in estuaries or at beaches affected by stormwater runoff or river discharges • Environmental degradation can impact on spiritual connections. • Water pollution events can result in temporary closures for fishing			
Habitat Disturbance	• **Consumptive Use** associated with *Research & Education*	• **Safety, Health & Wellbeing** of *Recreational Fishing*, and *Commercial Fishing* • **Socialising & Sense of Community** of *Recreational Fishing*, and *Commercial Fishing* • **Enjoying the Biodiversity & Beauty of the Marine Estate** associated with *Recreation, Recreational Fishing, Commercial Fishing* and *Commercial & Charter Boating* • **Consumptive Use** associated with *Recreation, Recreational Fishing Commercial Fishing* and *Commercial & Charter Boating* • **Indirect Values** of *Recreational Fishing* and *Commercial Fishing* • **Direct Values** of *Recreational Fishing* • **Viability of Businesses** of *Commercial Fishing* and *Commercial & Charter Boating*	• Impacts on diving and snorkelling (recreation), recreational fishing, commercial fishing and tourism. • Degraded landscape impacts cultural fishing • Loss of undisturbed control sites required for scientific research	Regional	Current issue (now) Trending ↑	Limited
Reductions in abundances of top and lower order trophic levels (depletion of fish stocks)	• **Enjoying the Biodiversity & Beauty of the Marine Estate** associated with *Conservation of Environment & Heritage* • **Consumptive Use** associated with *Research & Education*	• **Safety, Health & Wellbeing** of *Recreational Fishing* and *Commercial Fishing* • **Socialising & Sense of Community** of *Recreational Fishing* and *Commercial Fishing* • **Enjoying the Biodiversity & Beauty of the Marine Estate** associated with *Recreation*, *Commercial Fishing* and *Recreational Fishing*. • **Consumptive Use** associated with *Recreation, Recreational Fishing, Commercial Fishing* and *Commercial & Charter Boating*. • **Indirect Values** of *Recreational Fishing* • **Viability of Businesses** associated with *Commercial & Charter Boating*	• Environmental degradation can impact on spiritual connections (e.g. totemic species, culturally significant species, links to Country, food sources). • Loss of undisturbed' control sites required for scientific research (not mitigated through marine parks in this bioregion) • Loss of availability of locally caught seafood, including as a tourism product associated with coastal holidays. • People are less likely to pay to go on a fishing			Limited

Use, Activity or Stressor	Social and Economic benefits of the marine estate that are at 'High' risk from the use/activity/stressor	Social and Economic benefits of the marine estate that are at 'Moderate' risk from the use/activity/stressor	Summary of Evidence	Spatial Extent of Risks	Temporal and Risk Trend	Confidence
		• **Direct Values** of *Recreational Fishing*	or snorkelling and diving commercial charter if there are reductions in biodiversity			
Pests and diseases	• **Safety, Health & Wellbeing** associated with *Aquaculture* • **Consumptive Use** associated with *Aquaculture* • **Viability of Businesses** of *Aquaculture*	Nil	• There is a history of pest and disease outbreaks in the Hawkesbury Bioregion having major adverse impacts on aquaculture, production, employment and the quality and reputation of seafood.	Regional	Current issue (now) Trending ↑	Limited
Modified freshwater flows / Estuary entrance management	Nil	• **Safety, Health & Wellbeing** of *Recreational Fishing* and *Commercial Fishing* • **Socialising & Sense of Community** of *Recreational Fishing* and *Commercial Fishing* • **Enjoying the Biodiversity & Beauty of the Marine Estate** of *Recreational Fishing* and *Commercial Fishing* • **Consumptive Use** of *Recreational Fishing* and *Commercial Fishing* • **Indirect Values** associated with *Recreation Fishing* and *Commercial Fishing* • **Viability of Businesses** of *Commercial Fishing* • **Direct Values** of *Recreational Fishing*	• Importance of safe navigable access (i.e. dangerous bar crossings) for commercial fishing effort • Modified flows change fish stocks	Regional	Current issue (now) Trending ↑	Limited
Climate Change *(based on a 50 year projection of impacts)*	• **Safety, Health & Wellbeing** associated with *Coastal Urban Settlement* • **Socialising & Sense of Community** associated with *Coastal Urban Settlement* • **Enjoying the Biodiversity & Beauty of the Marine Estate** associated with *Coastal Urban Settlement and Conservation of Environment and Heritage* • **Consumptive Use** associated with *Research & Education.* • **Indirect Values** associated with *Conservation of Environment & Heritage* • **Viability of Businesses** associated with *Coastal Urban Settlement*	• **Safety, Health & Wellbeing** associated with *Recreation, Cultural Fishing, Aquaculture, Maritime Related Activities*, and *Tourism & Accommodation.* • **Socialising & Sense of Community** associated with *Recreation, Cultural Fishing*, and *Tourism & Accommodation.* • **Enjoying the Biodiversity & Beauty of the Marine Estate** associated with *Recreation, Cultural Fishing*, and *Tourism & Accommodation.* • **Consumptive Use** associated with *Recreation, Cultural Fishing, Aquaculture,* and *Tourism & Accommodation.* • **Tangible Aboriginal Cultural Heritage** associated with *Recreation* and *Cultural Fishing.* • **Intangible Aboriginal Heritage** associated with *Recreation* and *Cultural Fishing* • **Indirect Values** of *Cultural Fishing* and *Tourism & Accommodation.* • **Viability of Businesses** of *Cultural Fishing, Aquaculture, Ports & Shipping, Maritime Related Activities*, and *Tourism & Accommodation.* • **Direct Values** of *Cultural Fishing*	• Limited adaptation/retreat options and the long design life/functional life of many built assets • Loss of sandy beach (and associated amenity / social / economic values) • Sea level rise, temperature changes etc. associated with climate change could affect species distribution, abundance etc. which would have flow on affects to the social and economic benefits • Acidification threat to oyster shells, temperature change, increasing storms (damage to aquaculture racks)	Regional	Some risks now but likely consequence in next 20 years Trending ↑	Inferred
Adverse wildlife interaction	Nil	• **Safety, Health & Wellbeing** for *Recreation* • **Socialising & Sense of Community** for *Recreation*	• Sharks and others; cumulative and threshold effect (hysteria and builds from a political and news perspective).	Regional	Current issue (now) Trending ↑	Limited

Use, Activity or Stressor	Social and Economic benefits of the marine estate that are at 'High' risk from the use/activity/stressor	Social and Economic benefits of the marine estate that are at 'Moderate' risk from the use/activity/stressor	Summary of Evidence	Spatial Extent of Risks	Temporal and Risk Trend	Confidence
Health & safety (injury, illness, death)	Nil	Nil	Nil	Regional	Current issue (now) Trending #	Inferred
Effect of Regulation	• **Safety, Health & Wellbeing** associated with *Commercial Fishing* • **Socialising & Sense of Community** associated with *Commercial Fishing* • **Consumptive Use** associated with *Commercial Fishing* and *Conservation of Environment & Heritage*. • **Tangible Aboriginal Cultural Heritage** associated with *Conservation of Environment & Heritage* • **Indirect Values** of *Commercial Fishing* • **Viability of Businesses** of *Commercial Fishing* and *Aquaculture*	• **Safety, Health & Wellbeing** of *Aquaculture, Recreational Boating* and *Maritime Related Activities*. • **Socialising & Sense of Community** of *Recreational Boating* • **Enjoying the Biodiversity & Beauty of the Marine Estate** of *Recreational Boating* • **Consumptive Use** of *Aquaculture* and *Water Transport Services*. • **Viability of Businesses** associated with *Commercial & Charter Boating, Water Transport Services* and *Maritime Related Activities.* • **Direct Values** associated with *Recreational Boating*	• Safety implications in crews (limit to one member); • Uncertainty in regulation of commercial fishing leading to mental health issues; • Concentration of effort in areas (particularly estuaries) as more areas progressively closed • Beach hauls are precluded from involving people creating additional barriers between fishers and the public (loss of social licence); • Inadequate regulation to protect significant species has impacted in the benefit of religious/spiritual significance being realised • Past regulatory changes have impacted on the ability of the Aboriginal community to obtain/maintain commercial fishing licences despite strong historic links to the industry. • In regard to Aquaculture economically and bureaucratically inefficient regulation or increased compliance costs • Regulation not adequate to protect cultural landscapes (Shellharbour example) • Increased compliance e.g. erosion from River cats on the Parramatta River (threat to benefit: consumption of catching a ferry) • Maritime Industry has identified planning regulation as the biggest constraint to growth.	Regional	Current issue (now) Trending #	Inferred
Restriction of Access	• **Safety, Health & Wellbeing** associated with *Tourism & Accommodation*. • **Socialising & Sense of Community** associated with *Tourism & Accommodation*. • **Enjoying the Biodiversity & Beauty of the Marine Estate** associated with *Tourism & Accommodation.* • **Consumptive Use** associated with *Tourism & Accommodation.* • **Tangible Aboriginal Cultural Heritage** associated with *Cultural Fishing* • **Direct Values** associated with *Tourism &*	• **Safety, Health & Wellbeing** of *Recreational Fishing, Cultural Fishing, Aquaculture, Recreational Boating, Cruise Shipping* and *Maritime Related Activities*. • **Socialising & Sense of Community** of *Recreational Fishing, Cultural Fishing, Recreational Boating* and *Cruise Shipping*. • **Enjoying the Biodiversity & Beauty of the Marine Estate** of *Recreational Fishing, Cultural Fishing*, and *Recreational Boating.* • **Consumptive Use** of *Recreational Fishing, Aquaculture* and *Recreational Boating*. • **Intangible Aboriginal Heritage** of *Cultural Fishing* • **Indirect Values** of *Recreational Fishing*	• Disabled access issue for islands in the bioregion • Land ownership and Restrictions on access to camping/collecting places where social events occur impacts Aboriginal Cultural Significance (implications of Crown Lands Review). • Foreshore development has reduced angler access and is an issue where high density developments unofficially "privatise the shore line" and curtail access to fishing spots. An example is Barangaroo Park which has opened with no recreational fishing allowed	Regional	Current issue (now) Trending ↑	Inferred

Use, Activity or Stressor	Social and Economic benefits of the marine estate that are at 'High' risk from the use/activity/stressor	Social and Economic benefits of the marine estate that are at 'Moderate' risk from the use/activity/stressor	Summary of Evidence	Spatial Extent of Risks	Temporal and Risk Trend	Confidence
	Accommodation.	• **Viability of Businesses** of *Recreational Fishing, Aquaculture, Cruise Shipping, Ports & Shipping, Water Transport Services* and *Maritime Related Activities*. • **Direct Values** of *Recreational Fishing, Cultural Fishing, Recreational Boating* and *Cruise Shipping*.	from the foreshore. • Limited access infrastructure and ; marine protected areas and closures (fishing or green zones) reduce recreational fishing opportunities • Limited access infrastructure for Cruise Shipping / social licence to operate • General lack of infrastructure / storage/berthing facilities.			
Funding and Support	• **Safety, Health & Wellbeing** associated with *Research & Education* • **Viability of Businesses** associated with *Research & Education*	• **Safety, Health & Wellbeing** of *Water Transport Services* • **Viability of Businesses** of *Water Transport Services*	• In regard to research and education, the threat identified as change in government funding priorities	Regional	Current issue (now) Trending ↑	Adequate

5 Integrating the Environmental, Social and Economic Assessments

5.1 Environmental Assets that underpin Social and Economic Benefits

It is recognised in the TARA process that many of the benefits across the marine estate in the bioregion are closely linked and interdependent.

This was also demonstrated by the risk ratings applied by MEMA agencies and experts as part of the workshop process, noting the key environmental assets and their benefits (such as clean water and healthy ecosystems) underpin social and economic uses of the marine estate which, in turn, provide social and economic benefits to both direct users and the NSW community as a whole.

Table 5-1 has sought to identify key interdependencies between the social and economic benefit categories and the environmental asset categories based on the feedback from the workshop process and analysis of the risk scores.

Items in Table 5-1 that have a green ✓ tick represent social and economic benefits that are the most reliant on the environmental condition and quality of the marine estate. These include consumptive uses of the marine estate (e.g. all forms of fishing and aquaculture), and the range of primary and secondary contact recreational and tourism activities. Items with an orange ● circle have some dependency, but less dependency than red tick categories.

Items in Table 5-1 with a red - dash are less (or not) reliant on the environmental condition and quality of the marine estate. These include transport uses (such as shipping and water transport) and other commercial uses of the marine estate such as extraction and mining.

While all benefits of the marine estate are important to protect, in considering management options and responses in the next stage of MEMA planning, those benefits in Table 5-1 with red ticks are critically important as protection of these attributes will protect environmental benefits as well as associated social and economic benefits.

Table 5-1 Relationship between Social and Economic Benefits provided by Uses and Activities of the Marine Estate and Environmental Benefits Provided by Environmental Assets

Uses and activities of the marine estate that generate social and economic benefits	Environmental Asset Categories		
	Clean Water	Healthy Marine Habitats and Assemblages	Presence of Threatened and Protected Species
Recreational Fishing	✓	✓	-
Commercial Fishing	✓	✓	-
Cultural Fishing	✓	✓	●
Aquaculture	✓	✓	-
Recreation	✓	●	●
Recreational Boating	●	●	-
Research & Education	✓	✓	✓
Cruise Shipping	●	-	-
Ports & Shipping	-	-	-
Commercial Boating and Charters	●	●	✓
Maritime Related Activities and Infrastructure	-	-	-
Tourism & Accommodation	●	●	●
Coastal Urban Settlement	●	-	-
Water Transport Services	●	-	-
Marine Extraction and Offshore Disposal Activities	-	-	-
Conserving Environment and Heritage	✓	✓	✓

Legend:

✓ = Highly Dependant

● = Somewhat Dependant

- = Limited or no dependency

5.2 Uses, Activities and Stressors Common to Both Assessments

In order to combine the risk ratings across the environmental, social and economic components of the TARA for the HSMB, a list of common uses, activities and stressors was identified. How the use, activity and stressor categories were merged between the assessments is shown in Table 5-2.

These combined categories form the basis for the integrated presentation of risks to assets and benefits presented below in Section 5.3.

Table 5-2 Combined Categories

Combined Category	Category in the Social and Economic Assessment	Categories in Environment Assessment - Coastline/Marine Areas	Categories in Environment Assessment - Estuaries
Human Uses and Activities			
Recreational Fishing	Recreational Fishing	Includes all Recreational Fishing threat sub-categories	Includes all Recreational Fishing threat sub-categories
Commercial Fishing	Commercial Fishing	Includes all Commercial Fishing threat sub-categories	Includes all Commercial Fishing threat sub-categories
Cultural Fishing	Cultural Fishing	Aboriginal Cultural Fishing	Aboriginal Cultural Fishing
Aquaculture	Aquaculture	n/a	Aquaculture (Oyster Farming)
Recreational Boating	Recreational Boating	Recreational Boating separate from broader category of Recreation and Tourism	Recreational Boating separate from broader category of Recreation and Tourism
Recreation and Tourism	Recreation and tourism including snorkelling and diving, swimming and surfing, 4WD	Includes: Recreation and Tourism Charter fishing Whale watching tours	Includes: Recreation and Tourism Charter fishing Whale watching tours
Shipping and Commercial Vessels	Shipping	Large and small commercial vessels	Large and small commercial vessels
Foreshore/Urban development	Foreshore/urban development	Foreshore development and beach nourishment	Foreshore development and beach nourishment

Combined Category	Category in the Social and Economic Assessment	Categories in Environment Assessment - Coastline/Marine Areas	Categories in Environment Assessment - Estuaries
Environmental Stressors (noting some of these may result from the above uses and activities)			
Water pollution and sediment contamination	Includes: Water pollution Sediment contamination	Includes: Urban stormwater, Agricultural runoff, Industrial discharges, Thermal discharges, Sewage effluent	Includes: Urban stormwater, Agricultural runoff, Industrial discharges, Thermal discharges, Sewage effluent
Clearing, dredging and excavation activities	Habitat disturbance	Includes: Vegetation clearing Dredging Service Infrastructure Extraction and Mining	Includes: Vegetation clearing Dredging Service Infrastructure Extraction and Mining
Hydrological changes	Includes: Estuary openings Modified freshwater flows	Includes: Hydrological modifications Estuary entrance modifications Modified freshwater flows	Includes: Hydrological modifications Estuary entrance modifications Modified freshwater flows
Climate change[3] (50 year projection)	Climate change	Includes all climate change threat sub-categories	Includes all climate change threat sub-categories

5.3 Key Risks Operating Across Environmental, Social and Economic Benefits

In combining the threat and risk data together with the 12 combined categories identified in Section 5.2, Table 5-3 to Table 5-15 provides an overview of risks across the full suite of environmental assets and social and economic benefits derived from the marine estate.

In reading the tables, please note the following instructions:

- Each table shows the effect of the use, activity or stressor (as a potential threat) on the environmental assets of the marine estate and the social and economic benefits that accrue from uses and activities in the marine estate for the HSMB.
- Each coloured box in the tables shows the specific risk that has been identified by MEMA agencies and experts as part of TARA (as referenced in Table 3-1, Table 3-2, and Table 4-1). The tables show all high risks, moderate risk and low risks (minimal risks are excluded) that have been identified for the given use, activity or stressor.
- Risks to environmental assets of the marine estate in the HSMB from the use, activity or stressor include both the estuaries and the coastline/marine planning areas as indicated. These are shown in the top row of the table.

[3] Note that the 50 year projection of climate change has been selected for integrated reporting as it was the common timeframe considered across both the environmental and social and economic assessments.

- Risks to social benefits of the marine estate (such as safety, health and wellbeing; socialising/sense of enjoyment and aboriginal cultural heritage) from the use, activity or stressor are shown in the middle row of the table.
- Risks to economic benefits of the marine estate (such as impacts on direct and indirect economic values and the viability of businesses) from the use, activity or stressor are shown in the bottom row of the table.
- The table shows that in some instances, activities can be a threat to itself e.g. the effects of overcrowding and antisocial behaviour from some recreational fishers can have an impact on the safety, health and wellbeing and sense of enjoyment of other recreational fishers.

Further guidance on how to interpret the tables is provided in the diagram below.

Risks from Recreational Fishing (EXAMPLE ONLY)

The columns of the table show all the 'High'. 'Moderate' and 'Low' Risks that were attributed to Recreational Fishing (as a potential threat) to an Environmental Asset or Social and Economic Benefit category in the bioregion identified as part of TARA

The rows of the table relate to the environmental assets, social benefits and economic benefits of the marine estate in the bioregion that are at risk from recreational fishing identified as part of TARA

	High Risks	Moderate Risks	Low Risks
Environmental Assets	**Species Protected under the TSA** in the Coastline/Marine and Estuarine Areas	The specific risk from recreational fishing attributed to **social benefits** - e.g. there is a moderate risk that recreational fishing is impacting on social values associated with the consumptive use for other recreation activities, other recreational fishers, cultural fishing and conservation	
Social Benefits	The specific risk from recreational fishing attributed to **environmental assets** – e.g. recreational fishing has a high risk to species protected under the Threatened Species Act in both the continental shelf and in estuarine areas	**Consumptive Use** associated with Recreation, Recreational Fishing, Cultural Fishing, and Conservation	
Economic Benefits		**Viability of Businesses** associated with Commercial Fishing, Aquaculture and Conservation	The specific risk from recreational fishing attributed to **economic benefits** – e.g. there is a moderate risk that recreational fishing activities will impact the viability of business associated with commercial fishing, aquaculture and to conservation

Table 5-3 Threats to environmental assets and social and economic benefits arising from the activity of Recreational Fishing

	High Risks	Moderate Risks	Low Risks
Environmental Assets	**Species Protected under the TSA** in the Coastline/Marine and Estuarine Areas	**Shallow Reefs** in the Coastline/Marine Area **Rocky Shores** in the Coastline/Marine Area **Pelagic Assemblages** in Estuarine Areas **Subtidal Reefs** in Estuarine Areas **Species Protected under FMA** in the Coastline/Marine Area **Shallow and soft sediments** in Estuarine Areas	**Seagrass** in Estuarine Areas **Mangrove** in Estuarine Areas **Rocky Shores** in Estuarine Areas **Beach and Mudflats** in Estuarine Areas **Species Protected under FMA** in Estuarine Areas
Social Benefits	**Safety, health and wellbeing** for Commercial Fishing **Socialising and sense of enjoyment** for Commercial Fishing **Consumptive Use** associated with Commercial Fishing and Research and Education **Intangible Aboriginal Heritage** associated with Conservation	**Safety, health and wellbeing** associated with Recreation, Recreational Fishing, Cultural Fishing, Aquaculture and Conservation. **Socialising and sense of enjoyment** associated with Recreation, Recreational Fishing, Cultural Fishing, Aquaculture, Conservation, and Marine Related Activities. **Enjoying biodiversity and beauty** associated with Recreation, Recreational Fishing, Cultural Fishing, Commercial Fishing, and Conservation. **Consumptive Use** associated with Recreation, Recreational Fishing, Cultural Fishing, and Conservation. **Intangible Aboriginal Heritage** associated with Recreation Cultural Fishing. **Tangible Aboriginal Cultural Heritage** associated with Recreation Cultural Fishing.	**Consumptive Use** associated with Aquaculture **Tangible Aboriginal Cultural Heritage** associated with Conservation.
Economic Benefits		**Indirect Values** associated with Recreation, Recreational Fishing, and Commercial Fishing. **Viability of Businesses** associated with Commercial Fishing, Aquaculture and Conservation. **Direct Values** associated with Recreation Recreational Fishing.	

Table 5-4 Threats to environmental assets and social and economic benefits arising from the activity of Commercial Fishing

	High Risks	Moderate Risks	Low Risks
Environmental Assets		**Pelagic Assemblages** in the Coastline/Marine and Estuarine Areas **Deep soft Sediments** in the Coastline/Marine Area **Shallow and soft sediments** in Estuarine Areas **Species Protected under FMA** in the Coastline/Marine Area **Species Protected under TSA** in the Coastline/Marine and Estuarine Areas **Shallow Reefs** in the Coastline/Marine Area	**Seagrass** in Estuarine Areas **Beach and Mudflats** in Estuarine Areas **Species Protected under FMA** in Estuarine Areas
Social Benefits	**Safety, health and wellbeing** associated with Commercial Fishing. **Consumptive Use** associated with, Recreational Fishing, Research and Education. **Socialising and sense of enjoyment** associated with Recreational Fishing and Commercial Fishing **Intangible Aboriginal Heritage** associated with Conservation.	**Safety, health and wellbeing** associated with, Recreational Fishing, Cultural Fishing, Aquaculture, Conservation. **Intangible Aboriginal Heritage** associated with Cultural Fishing. **Socialising and sense of enjoyment** associated with Cultural Fishing, Aquaculture, Conservation, and Marine Related Activities. **Tangible Aboriginal Cultural Heritage** associated with Cultural Fishing. **Enjoying biodiversity and beauty** associated with, Recreational Fishing, Cultural Fishing, Conservation. **Consumptive Use** associated with Cultural Fishing, Conservation.	**Safety, health and wellbeing** associated with Recreation, Recreational Boating. **Consumptive Use** associated with Recreation Aquaculture, Recreational Boating, Commercial & Charter Boating. **Socialising and sense of enjoyment** associated with Recreation, Recreational Boating. **Tangible Aboriginal Cultural Heritage** associated with Recreation, Recreational Boating, Conservation. **Enjoying biodiversity and beauty** associated with Recreation.
Economic Benefits	**Indirect Values** associated with Recreational Fishing **Viability of Businesses** associated with Commercial Fishing.	**Indirect Values** associated with Commercial Fishing. **Direct Values** associated with Recreational Fishing. **Viability of Businesses** associated with Aquaculture, Research and Education, Conservation and Marine Related Activities.	**Indirect Values** associated with Recreation **Direct Values** associated with Recreation. **Viability of Businesses** associated with Commercial & Charter Boating.

Table 5-5 Threats to environmental assets and social and economic benefits arising from the activity of Cultural Fishing

	High Risks	Moderate Risks	Low Risks
Environmental Assets			
Social Benefits	**Consumptive Use** associated with Research and Education.	**Safety, health and wellbeing** associated with Conservation. **Socialising and sense of enjoyment** associated with Conservation. **Enjoying biodiversity and beauty** associated with Conservation. **Consumptive Use** associated with, Recreational Fishing, Commercial Fishing, Conservation.	
Economic Benefits		**Indirect Values** associated with Conservation. **Viability of Businesses** associated with Commercial Fishing, Research and Education, Conservation.	

Table 5-6 Threats to environmental assets and social and economic benefits arising from the activity of Aquaculture

	High Risks	Moderate Risks	Low Risks
Environmental Assets		**Seagrass** in Estuarine Areas **Species Protected under TSA** in Estuarine Areas	**Saltmarsh** in Estuarine Areas **Mangrove** in Estuarine Areas **Beach and Mudflats** in Estuarine Areas **Rocky Shores** in Estuarine Areas **Species Protected under FMA** in Estuarine Areas
Social Benefits	**Consumptive Use** associated with Research and Education. **Intangible Aboriginal Heritage** associated with Conservation.		**Safety, health and wellbeing** associated with Recreation Recreational Boating. **Socialising and sense of enjoyment** associated with Recreation Recreational Boating. **Enjoying biodiversity and beauty** associated with Recreation Recreational Boating. **Consumptive Use** associated with Recreation Recreational Boating. **Tangible Aboriginal Cultural Heritage** associated with Recreation, and Conservation. **Intangible Aboriginal Heritage** associated with Recreation.
Economic Benefits		**Indirect Values** associated with Cultural Fishing. **Viability of Businesses** associated with Cultural Fishing, Research & Education. **Direct Values** associated with Cultural Fishing.	**Viability of Businesses** associated with Aquaculture. **Direct Values** associated with Recreation Recreational Boating.

Table 5-7 Threats to environmental assets and social and economic benefits arising from the activity of Recreational Boating

	High Risks	Moderate Risks	Low Risks
Environmental Assets	**Seagrass** in Estuarine Areas **Beach and Mudflats** in Estuarine Areas **Shallow soft sediments** in Estuarine Areas **Species Protected under FMA** in Estuarine Areas	**Species Protected under TSA** in the Coastline/Marine and Estuarine Areas **Estuarine waters** in Estuarine Areas **Rocky Shores** in Estuarine Areas **Pelagic Assemblages** in Estuarine Areas **Subtidal reefs** in Estuarine Areas	**Shallow Reefs** in the Coastline/Marine Area **Mangrove** in Estuarine Areas **Deep Reefs** in the Coastline/Marine Area
Social Benefits	**Consumptive Use** associated with Research and Education. **Intangible Aboriginal Heritage** associated with Conservation.	**Safety, health and wellbeing** associated with Recreation and Aquaculture. **Enjoying biodiversity and beauty** associated with Recreation. **Socialising and sense of enjoyment** associated with Recreation Aquaculture. **Consumptive Use** associated with Recreation. **Tangible Aboriginal Cultural Heritage** associated with Recreation. **Intangible Aboriginal Heritage** associated with Recreation.	
Economic Benefits		**Viability of Businesses** associated with Aquaculture and Research and Education. **Indirect Values** associated with Recreation. **Direct Values** associated with Recreation.	

Table 5-8 Threats to environmental assets and social and economic benefits arising from the activity of Recreation and Tourism Activities

	High Risks	Moderate Risks	Low Risks
Environmental Assets	**Beaches** in the Coastline/Marine Area **Species Protected under FMA** in the Coastline/Marine Area **Species Protected under TSA** in the Coastline/Marine and Estuarine Areas	**Beach and Mudflats** in Estuarine Areas **Saltmarsh** in Estuarine Areas	**Seagrass** in Estuarine Areas **Shallow soft sediments** in Estuarine Areas **Subtidal Reefs** in Estuarine Areas **Pelagic Assemblages** in Estuarine Areas **Species Protected under FMA** in Estuarine Areas
Social Benefits	**Intangible Aboriginal Heritage** associated with Conservation.	**Safety, health and wellbeing** associated with Recreation Aquaculture, Tourism & Accommodation. **Socialising and sense of enjoyment** associated with Recreation Aquaculture, Conservation, Tourism & Accommodation. **Enjoying biodiversity and beauty** associated with Recreation Conservation, Tourism & Accommodation. **Consumptive Use** associated with Recreation Research & Education, Conservation, Tourism & Accommodation. **Tangible Aboriginal Cultural Heritage** associated with Recreation. **Intangible Aboriginal Heritage** associated with Recreation.	**Safety, health and wellbeing** associated with Commercial Fishing, Recreational Boating. **Enjoying biodiversity and beauty** associated with Recreational Boating. **Consumptive Use** associated with Commercial Fishing, Aquaculture, and Recreational Boating. **Tangible Aboriginal Cultural Heritage** associated with Conservation.
Economic Benefits		**Indirect Values** associated with Tourism & Accommodation. **Viability of Businesses** associated with Aquaculture, Tourism & Accommodation. **Direct Values** associated with Recreation.	**Indirect Values** associated with Commercial Fishing. **Viability of Businesses** associated with Commercial Fishing. **Direct Values** associated with Recreational Boating.

Table 5-9 Threats to environmental assets and social and economic benefits arising from the activity of Shipping and Commercial Vessels

	High Risks	Moderate Risks	Low Risks
Environmental Benefits	**Deep Soft Sediments** in the Coastline/Marine Area **Deep Reefs** in the Coastline/Marine Area **Species Protected under TSA** in the Coastline/Marine and Estuarine Areas **Mangrove** in Estuarine Areas	**Species Protected under FMA** in the Coastline/Marine and Estuarine Areas **Beach and Mudflats** in Estuarine Areas **Estuarine waters** in Estuarine Areas **Shallow soft sediments** in Estuarine Areas **Saltmarsh** in Estuarine Areas **Rocky Shores** in Estuarine Areas **Deep Reefs** in the Coastline/Marine	**Ocean waters** in the Coastline/Marine Area **Beaches** in the Coastline/Marine Area **Pelagic Assemblages** in the Coastline/Marine & Estuary Areas **Subtidal Reefs** in Estuarine Areas **Seagrass** in Estuarine Areas **Rocky Shores** in the Coastline/Marine Area **Shallow Reefs** in the Coastline/Marine Area
Social Benefits		**Enjoying biodiversity and beauty** associated with, Conservation. **Intangible Cultural Heritage** associated with Conservation.	**Consumptive Use** associated with Commercial Boating & Charters, Conservation, and Research & Education. **Enjoying biodiversity and beauty** associated with Commercial Boating & Charters. **Tangible Aboriginal Cultural Heritage** associated with Conservation.
Economic Benefits		**Viability of Businesses** associated with Research and Education, Ports and Shipping	**Viability of Businesses** associated with Boating Commercial & Charter

Table 5-10 Threats to environmental assets and social and economic benefits arising from the activity of Foreshore/Urban Development

	High Risks	Moderate Risks	Low Risks
Environmental Assets	**Beaches** in the Coastline/Marine Area **Species Protected under TSA** in the Coastline/Marine and Estuarine Areas **Beach and Mudflats** in Estuarine Areas **Shallow soft sediments** in Estuarine Areas	**Saltmarsh** in Estuarine Areas **Mangrove** in Estuarine Areas **Seagrass** in Estuarine Areas **Rocky Shores** in the Coastline/Marine and Estuarine Areas **Species Protected under FMA** in Estuarine Areas	**Shallow soft sediments** in the Coastline/Marine Area
Social Benefits	**Consumptive Use** associated with Research & Education **Intangible Aboriginal Heritage** associated with Cultural Fishing, Conservation.	**Safety, health and wellbeing** associated with Aquaculture, Conservation, Tourism & Accommodation. **Socialising and sense of enjoyment** associated with Recreation Aquaculture, Conservation, Tourism & Accommodation. **Enjoying biodiversity and beauty** associated with Recreation Conservation, Tourism & Accommodation. **Consumptive Use** associated with Recreation Conservation, Tourism & Accommodation. **Tangible Aboriginal Cultural Heritage** associated with Recreation Cultural Fishing, Conservation. **Intangible Aboriginal Heritage** associated with Recreation	**Safety, health and wellbeing** associated with Cultural Fishing. **Socialising and sense of enjoyment** associated with Cultural Fishing. **Enjoying biodiversity and beauty** associated with Cultural Fishing,. **Consumptive Use** associated with Cultural Fishing,. **Tangible Aboriginal Cultural Heritage** associated with Cultural Fishing. **Intangible Aboriginal Heritage** associated with Cultural Fishing,.
Economic Benefits		**Indirect Values** associated with Recreation Conservation, Tourism & Accommodation. **Viability of Businesses** associated with Aquaculture, Research & Education and Ports & Shipping, Tourism & Accommodation. **Direct Values** associated with Recreation.	**Viability of Businesses** associated with Conservation, Cultural Fishing. **Direct Values** associated with Conservation, Cultural Fishing. **Indirect Values** associated with Cultural Fishing

Table 5-11 Threats to environmental assets and social and economic benefits arising from the activity of Water Pollution and Sediment Contamination

	High Risks	Moderate Risks	Low Risks
Environmental Assets	**Species Protected under TSA** in the Coastline/Marine and Estuarine Areas	**Beaches** in the Coastline/Marine Area	**Ocean waters** in the Coastline/Marine Area
	Estuarine waters in Estuarine Areas	**Rocky Shores** in the Coastline/Marine and Estuarine Areas	**Shallow soft sediments** in the Coastline/Marine Area
	Saltmarsh in Estuarine Areas	**Shallow Reefs** in the Coastline/Marine Area	**Deep Soft Sediments** in the Coastline/Marine Area
	Seagrass in Estuarine Areas	**Mangrove** in Estuarine Areas	**Species Protected under FMA** in the Coastline/Marine Area
	Shallow soft sediments in Estuarine Areas	**Pelagic Assemblages** in the Coastline/Marine Area	
	Subtidal reefs in Estuarine Areas	**Deep Reefs** in the Coastline/Marine Area	
	Beach and Mudflats in Estuarine Areas		
	Pelagic Assemblages in Estuarine Areas		
	Species Protected under FMA in Estuarine Areas		
Social Benefits	**Safety, health and wellbeing** associated with Aquaculture.	**Safety, health and wellbeing** associated with Recreation, Recreational Fishing, Commercial Fishing, Conservation, and Commercial & Charter Boating.	**Safety, health and wellbeing** associated with Cultural Fishing, Tourism & Accommodation.
	Consumptive Use associated with Aquaculture, Research & Education.	**Socialising and sense of enjoyment** associated with Recreation, Recreational Fishing, Commercial Fishing, and Conservation.	**Socialising and sense of enjoyment** associated with Cultural Fishing, Tourism & Accommodation, and Commercial & Charter Boating.
		Enjoying biodiversity and beauty associated with Recreation, Recreational Fishing, Commercial Fishing, Conservation, and Commercial & Charter Boating.	**Enjoying biodiversity and beauty** associated with Cultural Fishing, Tourism & Accommodation.
		Consumptive Use associated with Recreation, Recreational Fishing, Commercial Fishing, and Commercial & Charter Boating.	**Consumptive Use** associated with Cultural Fishing, Conservation, and Tourism & Accommodation.
		Tangible Aboriginal Cultural Heritage associated with Recreation.	**Tangible Aboriginal Cultural Heritage** associated with Cultural Fishing.
		Intangible Aboriginal Heritage associated with Recreation.	**Intangible Aboriginal Heritage** associated with Cultural Fishing, Conservation.
Economic Benefits	**Viability of Businesses** associated with Aquaculture.	**Indirect Values** associated with Recreation, Recreational Fishing, Commercial Fishing, Conservation.	**Indirect Values** associated with Cultural Fishing, Tourism & Accommodation.
		Viability of Businesses associated with Commercial Fishing, Conservation, and Commercial & Charter Boating.	**Viability of Businesses** associated with Cultural Fishing, Tourism & Accommodation, Commercial & Charter Boating, and Ports & Shipping.
		Direct Values associated with Recreation, Recreational Fishing, and Conservation.	**Direct Values** associated with Cultural Fishing, Tourism & Accommodation.

Table 5-12 Threats to environmental assets and social and economic benefits arising from the activity of Clearing, Dredging and Excavation Activities

	High Risks	Moderate Risks	Low Risks
Environmental Assets	**Species Protected under TSA** in the Coastline/Marine and Estuarine Areas **Estuarine waters** in Estuarine Areas **Saltmarsh** in Estuarine Areas **Shallow soft sediments** in Estuarine Areas **Species Protected under FMA** in Estuarine Areas	**Beaches** in the Coastline/Marine Area **Deep Soft Sediments** in the Coastline/Marine Area **Seagrass** in Estuarine Areas **Mangrove** in Estuarine Areas **Beach and Mudflats** in Estuarine Areas **Pelagic Assemblages** in Estuarine Areas	**Ocean waters** in the Coastline/Marine Area **Shallow soft sediments** in the Coastline/Marine Area **Subtidal Reefs** in Estuarine Areas **Rocky Shores** in the Coastline/Marine and Estuarine Areas **Shallow Reefs** in the Coastline/Marine Area **Pelagic Assemblages** in the Coastline/Marine Area
Social Benefits	**Consumptive Use** associated with Research & Education.	**Safety, health and wellbeing** associated with, Recreational Fishing, Commercial Fishing. **Socialising and sense of enjoyment** associated with, Recreational Fishing, Commercial Fishing. **Enjoying biodiversity and beauty** associated with Recreation, Recreational Fishing, Commercial Fishing, Commercial & Charter Boating. **Consumptive Use** associated with Recreation, Recreational Fishing, Commercial Fishing, and Commercial & Charter Boating.	**Safety, health and wellbeing** associated with Recreation. **Socialising and sense of enjoyment** associated with Recreation **Tangible Aboriginal Cultural Heritage** associated with Recreation Conservation, Cultural Fishing. **Intangible Aboriginal Heritage** associated with Recreation Conservation, Cultural Fishing.
Economic Benefits		**Indirect Values** associated with Recreational Fishing and Commercial Fishing **Viability of Businesses** associated with Commercial Fishing, Commercial & Charter Boating. **Direct Values** associated with Recreational Fishing.	**Indirect Values** associated with Recreation Conservation. **Direct Values** associated with Recreation.

Table 5-13 Threats to environmental assets and social and economic benefits arising from the activity of Modified Freshwater Flows/Estuary Entrance Management

	High Risks	Moderate Risks	Low Risks
Environmental Assets	**Beaches** in the Coastline/Marine Area **Saltmarsh** in Estuarine Areas **Mangrove** in Estuarine Areas **Seagrass** in Estuarine Areas **Species Protected under FMA** in Estuarine Areas	**Estuarine waters** in Estuarine Areas **Beach and Mudflats** in Estuarine Areas **Shallow soft sediments** in Estuarine Areas **Pelagic Assemblages** in Estuarine Areas **Species Protected under TSA** in Estuarine Areas	**Shallow soft sediments** in Estuarine Areas **Subtidal Reefs** in Estuarine Areas **Rocky Shores** in Estuarine Areas
Social Benefits		**Safety, health and wellbeing** associated with, Recreational Fishing, Commercial Fishing. **Socialising and sense of enjoyment** associated with, Recreational Fishing, Commercial Fishing. **Enjoying biodiversity and beauty** associated with, Recreational Fishing, Commercial Fishing. **Consumptive Use** associated with, Recreational Fishing, Commercial Fishing.	**Safety, health and wellbeing** associated with Cultural Fishing, Commercial Fishing **Socialising and sense of enjoyment** associated with Cultural Fishing, Commercial Fishing **Enjoying biodiversity and beauty** associated with Cultural Fishing, Commercial Fishing **Consumptive Use** associated with Cultural Fishing, Commercial Fishing. **Tangible Aboriginal Cultural Heritage** associated with Cultural Fishing, Conservation. **Intangible Aboriginal Heritage** associated with Cultural Fishing, Conservation.
Economic Benefits		**Indirect Values** associated with Recreational Fishing, Commercial Fishing. **Viability of Businesses** associated with Commercial Fishing. **Direct Values** associated with Recreational Fishing.	**Indirect Values** associated with Conservation, Commercial Fishing. **Viability of Businesses** associated with Commercial Fishing.

Table 5-14 Threats to environmental assets and social and economic benefits arising from the activity of Climate Change (50 year timeframe)

	High Risks	Moderate Risks	Low Risks
Environmental Assets	**Ocean waters** in the Coastline/Marine Area **Beaches** in the Coastline/Marine Area **Beach and Mudflats** in Estuarine Areas **Species Protected under FMA** in Estuarine areas **Saltmarsh** in Estuarine Areas **Mangrove** in Estuarine Areas **Seagrass** in Estuarine Areas **Pelagic Assemblages** in the Coastline/Marine and Estuarine Areas **Shallow soft sediments** in the Coastline/Marine and Estuarine Areas **Subtidal Reef** in Estuarine Areas **Deep Soft Sediments** in the Coastline/Marine Area **Rocky Shores** in the Coastline/Marine and in Estuarine Areas **Species Protected under TSA** in the Coastline/Marine and Estuarine Areas	**Estuarine waters** in Estuarine Areas **Rocky Shores** in the Coastline/Marine Area **Shallow Reefs** in the Coastline/Marine Area **Deep Reefs** in the Coastline/Marine Area	
Social Benefits	**Safety, health and wellbeing** associated with Coastal Urban Settlements. **Socialising and sense of enjoyment** associated with Coastal Urban Settlement. **Enjoying biodiversity and beauty** associated with Coastal Urban Settlement and Conservation. **Consumptive Use** associated with Research & Education,	**Safety, health and wellbeing** associated with Recreation Cultural Fishing, Aquaculture, Marine Related activities, Tourism & Accommodation. **Socialising and sense of enjoyment** associated with Recreation Cultural Fishing, Tourism & Accommodation. **Enjoying biodiversity and beauty** associated with Recreation Cultural Fishing, Tourism & Accommodation. **Consumptive Use** associated with Recreation Cultural Fishing, Aquaculture, and Tourism & Accommodation. **Tangible Aboriginal Cultural Heritage** associated with Recreation Cultural Fishing. **Intangible Aboriginal Heritage** associated with Recreation Cultural Fishing.	**Safety, health and wellbeing** associated with, Recreational Fishing, Commercial Fishing, Conservation. **Socialising and sense of enjoyment** associated with, Recreational Fishing, Commercial Fishing, and Conservation. **Enjoying biodiversity and beauty** associated with, Recreational Fishing, and Commercial Fishing. **Consumptive Use** associated with, Recreational Fishing, and Commercial Fishing. **Tangible Aboriginal Cultural Heritage** associated with Conservation **Intangible Aboriginal Heritage** associated with Conservation.
Economic Benefits	**Viability of Businesses** associated with Coastal Urban Settlement. **Indirect Values** associated with Conservation.	**Indirect Values** associated with Cultural Fishing, and Tourism & Accommodation. **Viability of Businesses** associated with Cultural Fishing, Aquaculture, Ports & Shipping, Marine Related activities, and Tourism & Accommodation. **Direct Values** associated with Cultural Fishing.	**Indirect Values** associated with Recreation Recreational Fishing. **Direct Values**, associated with Recreation, Recreational Fishing, and Water Transport Services. **Viability of Businesses** associated with Commercial Fishing.

6 Conclusions and Recommendations

6.1 Summary of Key Findings from the TARA for Formulating Management Responses

Taken together with the matrices and information presented in the Appendices to this report, this first pass approach to TARA for the Hawkesbury Shelf bioregion has produced a comprehensive set of threats, benefits, and initial risks ratings (and associated evidence) that can be reviewed and further developed over time.

In summarising the key findings of this report for formulating management options and responses in the next stage of marine planning under the MEMA decision making process, the findings outlined below are considered the most relevant:

As outlined in **Section 3 of the report,** when considering the risk of threats to the **environmental assets** (and associated environmental benefits) of the marine estate:

- The combined outputs of Table 3-1 and Table 3-2 represent the threats to specific environmental assets in the marine estate in the bioregion.
- In general, there are more and higher risks from threats to environmental assets in the estuaries compared to environmental assets of the coastline and in marine areas.
- In considering spatial and temporal aspects, most key risks are considered to be operating at a whole of bioregion scale and are current issues that are happening now (e.g. at the present time) with the threat of the risk being realised expected to intensify or increase over time.
- Activities and issues generating highest threat to environmental assets of the bioregion (broadly prioritised from highest to lowest) were:
    - Climate change (50 year timeframe)
    - Urban stormwater discharge
    - Clearing, dredging & excavation activities
    - Shipping
    - Recreation & tourism
    - Recreational boating & boating infrastructure
    - Foreshore development
    - Agriculture diffuse source runoff
    - Point discharges
    - Estuary opening/modified freshwater flows
    - Recreational fishing
    - Commercial fishing
    - Aquaculture

- Charter fishing
- Charter activities

As outlined in **Section 4 of the report,** when considering the risk of threats to the social and economic benefits derived from the uses and activities of the marine estate:

- Table 4-1 outlines the threats to specific social and economic benefits provided by the uses and activities of the marine estate operating in the bioregion.
- Similar to the environmental assessment, most of these risks are considered to be operating at a bioregional scale and are current issues that are happening now (e.g. at the present time) with the threat of the risk being realised expected to intensify or increase over time.
- Activities and issues generating highest threat to social and economic benefits of the bioregion (broadly prioritised from highest to lowest) were:
  - Effect of Regulation
  - Access Availability
  - Climate Change
  - Recreational Fishing
  - Commercial Fishing
  - Sediment Contamination / Water Pollution
  - Recreation and Tourism
  - Foreshore Urban Development
  - Reductions in abundancies of top and lower order trophic levels (depletion of fish stocks)
  - Habitat Disturbance (loss of fish habitat)
  - Pests and Disease
  - Recreational Boating
  - Funding
  - Health and Safety
  - Cultural Fishing
  - Aquaculture
  - Modified Freshwater flows / Estuary entrance management
  - Shipping
  - Adverse Wildlife Interaction

As outlined in **Section 5 of the report**, when considering risks to the **full suite of benefits** provided by the marine estate (environment, social and economic) in the HSMB, the risks can be grouped as follows:

- 'Climate Change' (over a fifty year planning period) was clearly seen by participants in the TARA as the threat that poses the greatest risk to the assets and benefits provided by the marine estate with the largest number of high risks and moderate risks.
- 'Water Pollution and Sediment Quality' was the next greatest risk, rating highly on the basis that it affects the broadest range of assets, uses and activities and has a large number of high, moderate and low risks.
- 'Commercial Fishing', 'Recreational Fishing', 'Urban Development', 'Shipping and Commercial Vessels' and 'Clearing, Dredging and Excavation Activities' have similar risk profiles; with a small number of high risks but a large number of moderate risks, with many of the moderate risks crossing over several social and economic benefit categories.
- 'Recreational Boating', 'Modified Freshwater Flows and Estuary Opening', and 'Recreation and Tourism' could be grouped together on the basis that while still presenting high and moderate risks to some benefits, the overall number of risks is somewhat less than the above category.
- 'Aquaculture' and 'Cultural Fishing' were considered lower overall risks to the benefits provided by the marine estate but still contain particular aspects of high risk and moderate risks that required consideration in the next steps of the decision making process.

6.2 Next Steps – Risk Evaluation

As outlined previously, the TARA and its outputs as outlined in this report is a tool for the prioritisation of risks for treatment that will be further assessed as part of the management options stage of marine planning for the HSMB.

In this context, assignment of a 'High' or 'Moderate' risk level is a trigger for further interrogation of the threat to an asset or benefit but will not necessarily lead to a change to current management or regulations.

MEMA will evaluate the assigned risks through a risk evaluation process with a view to determining appropriate tolerance levels and treatment options consistent with the TARA framework and adopted standards for risk management.

6.3 Issues for Consideration in future TARAs

As it is a first-pass assessment, a number of issues and discussion points were raised by the participants of the workshops as part of the HSMB pilot that can be considered in future iterations of the TARA process for the marine estate. These are listed and discussed below (and in no particular order of importance):

- **Likelihood of a consequence occurring.** An important distinction of the TARA process as opposed to a traditional risk assessment is that likelihood does not specifically relate to the frequency of an impact occurring but rather the likelihood of a particular consequence level being realised. This approach poses an inherent challenge in the context of evaluating the efficiency and effectiveness of existing management controls; particularly if such controls are considered effective and that is the key justification for rating the risk on the lower end of the risk spectrum (e.g. low and minimal risks). While the effectiveness of management controls will

need to be further examined and resolved in the next stage of the MEMA decision making process, some key points to take away from the current workshops in relation to this issue are as follows: (i) that threats and pressures (as shown by the trend data collected) are mostly increasing as a result of increasing population, use and activity in marine estate and associated stressors in the medium term such as climate change, and (ii) that existing controls may not be wholly effective and should be reviewed for the key threats and stressors identified in the TARA both in terms of their current application and future trends.

- **Legacy Issues.** Related to the above, the TARA process for the HSMB has not sought to explicitly identify historical trends or other 'legacy issues' as part of assessment; it is focussed on: (i) the current conditions of environmental assets; (ii) the current benefits provided by the marine estate; (iii) current and future threats, (iv) how the threats are currently managed (e.g. existing controls) and (v) how this may change over the 20 year planning period. Several workshop participants have identified the risk evaluation process may be deficient because it has not effectively considered some of the key legacy issues in the region, examples of which include: historically depleted fish stocks and associated reductions in fishing effort, habitats such as saltmarsh that have been significantly removed by prior coastal development and the diminished capacity of the oyster industry following disease outbreaks. In a traditional risk context, one way of addressing these legacy issues would be to consider these depleted assets and benefits as 'sensitive receptors'. Using this approach, initial risk ratings (coming out of the TARA) related to these receptors could be further evaluated and increased where there was evidence of historical or legacy factors such as diminishing abundance or low resilience.
- **Geographic scale of threats.** It was often difficult for participants to address the scale of impact from threats and relate these to risk levels at a bioregional scale. By their nature, many of risks are highly localised but are occurring in multiple estuaries or areas of the bioregion. Conversely an impact that may be present a very high risk at the local scale will seem less significant when considered at the much larger scale of the whole of bioregion (with hundreds of kilometres of coastline and thousands of square kilometres of offshore area). To overcome this issue, it was resolved that the evidence be used to try and provide specific geographic examples of threats being realised wherever possible. The next stage of MEMA planning can then determine if these largely localised issues are best dealt with as part of the broader MEMA strategy implementation or alternatively through a more relevant delivery mechanisms such as a Coastal Zone Management Plan or other local planning instrument.
- **Landward planning boundary.** As with most marine parks on the coast around Australia, the landward boundary of the planning area for the marine estate is problematic as many of the key threatening processes and activities are occurring well outside of tidal waters but are nonetheless having an adverse effect on the benefits provided by the marine estate as a whole. Specific examples include land based sources of marine pollution, urban development in coastal zone, modification to downstream environmental flows and climate change. It is also noted that much of the information presented in the social and economic background report for the current TARA process has used a 50 km demarcation from the coast as having a potential interaction with the marine estate. This is a significantly larger catchment area than for example the current NSW coastal zone (~1km as defined in the *Coastal Protection Act 1979*), and referred to

in the NSW Coastal Policy and SEPP 71 – coastal protection. Harmonising the landward planning boundary of the MEMA decision making process with existing coastal zone policies and laws may be desirable in the context of future iterations of the TARA to resolve these inconsistencies.

- **Comparison to outputs of the community survey and stakeholder workshops.** In comparing the results of the TARA for the HSMB with outputs of the community survey and stakeholder workshops undertaken by MEMA agencies in Step 1, there would appear to be some strong correlations between the findings of the two processes. However, it is notable that some important threats identified as part of the consultation and engagement processes in Step 1 were not rated as significantly in the TARA process including for example, the risks from litter and marine debris, public access and safety, overfishing and illegal catches, and lack/loss of areas for tourism opportunities. These areas of potential misalignment between the community, the stakeholders, and the agencies and experts will need to be further investigated and addressed in the risk evaluation process.
- **Common categories of uses, activities and stressors across the marine estate.** As demonstrated in Table 5-2, closer alignment of the uses, activities and stressors being assessed across the range of environmental, social and economic benefits provided by the marine estate will be beneficial to ensure there is a clear 'line of sight' across and between the assessments. In particular it was noted as important by participants that environmental assets are not being managed in isolation of the social and economic benefits being provided by the marine estate, particularly where the social and economic benefit categories are reliant on a particular level of environmental benefit derived from these assets (as illustrated in Table 5-1).
- **Effect of regulation.** The perceived effect of current regulation (either under-regulation or over-regulation in the form of restrictions) is also noteworthy. In the community survey undertaken by Sweeney Research, the effect of over-regulation was seen as a key threatening process to the flow of economic and social benefits from the marine estate. The 'Effect of Regulation' was ranked as being similarly important in the social and economic TARA by MEMA agencies and experts in the context of how such regulation affects the flow of particular social and economic benefits (such as tourism, transport infrastructure, water transport services and aquaculture). On the other hand, under-regulation (or the perceived inadequacy of existing regulation) was seen as a potential threat to environmental benefits in the community survey. This contrasted with the adequacy of current regulations (as existing controls) as considered by MEMA agencies and experts as part of the environmental component of TARA – with the agencies often reducing their risk ratings on the basis of the perceived effectiveness of current regulations to protect marine environmental values. The perception of both over- and under-regulation are indicative of the need to further examine the effect of regulation in the next phase of MEMA planning (based on the risks identified in the TARA) particularly where existing regulations are not maximising protection of the key benefits of the marine estate that are held or agreed as being most critical to the NSW community, or alternatively reducing the risk of key threats that are affecting a broad range of benefits.
- **Refinement to risk tables.** Several refinements were suggested by participants to the consequence and likelihood scales used in the assessments (refer Appendix A) to remove

ambiguity. The most noteworthy were to: (i) examine wording in the environmental consequence scales around, 'shifts in the overall trophic/community structure and function' as this statement relates to fish stocks and their management; (ii) examine wording in the social consequence scales around, 'social benefits enjoyed by the NSW community at a bioregion scale or location' with a preference to reference to particular groups or subsets of the community as opposed to the whole community at a bioregional or local scale; and (iii) ensure greater clarity is provided in the wording of the likelihood scale for the ratings of 'possible' and 'unlikely' as some participants were interpreting possible as its common English definition (possible to occur within the timeframe of planning) as opposed to the specific guidance provided by MEMA around 'possible' being a probability of around 30% – 50% occurrence.

- **Matters specific to the social and economic assessment**. In reviewing the completed matrices presented in Appendix D for the social and economic assessment, the following observations during the workshop are relevant for consideration in future TARA approaches –
  - The social aspects of uses were often scored similarly across a threat category (e.g. scores for Participation and Enjoyment were the same) but with specific notation of instances where a use conflict threatened the enjoyment of the marine estate or related to a specific Consumptive Use (such as the ability to catch a fish). It is likely some simplification of these categories could be undertaken in future;
  - The Aboriginal cultural heritage aspects of uses involved assessment of both tangible (objects, places, items) and non-tangible (traditions, practices, spiritual beliefs) cultural heritage by the participants in the workshops based on the evidence presented in the Feary report and the Schnierer peer review report (refer References in Section 7). These benefit categories were often scored similarly by participants at the workshops noting the interlinked nature of the two concepts and the critical importance of the marine estate to indigenous people identified in the background information reports. It is likely that further work (including further engagement and the direct involvement with traditional owners to review risk ratings) is needed to be able to better understand and evaluate benefits to Aboriginal people from the marine estate including potential opportunities (as will be identified in later stages of the MEMA planning process);
  - In interpreting the high risk ratings placed on the effect of regulation, it will be important to ensure there is a strong nexus of understanding for why regulations have been imposed (what specific environmental asset or threat are they seeking to control) and that these regulations are reflected consistently with the TARA findings for key threats to environmental assets;
  - For the economic benefit aspects, the 'Viability of Businesses' was considered to be only relevant to commercial activities (unless in very special and isolated cases). Conversely, the 'Consumer surplus/enjoyment benefit' applied solely or mainly to recreational activities, and these had generally very low secondary economic impacts. This may need to be further examined in subsequent TARA assessments; and
  - The Indirect Value - Bequest/Existence Value column in the economic benefit assessment was often difficult to determine, sometimes irrelevant, but at other times considered by the

participants of the workshops to be very important, often providing both economic and social benefits. Given large areas of the offshore marine estate are not often visited or otherwise infrequently used by the majority of the population, providing a better definition of this benefit category will be important in subsequent TARA processes in order to capture the broad range of indirect users of marine estate benefits.

- **Improved evidence.** While a high degree of consensus was agreed between participants at both the environment and social and economic workshops, it is clear that further work is required to bolster the evidence to justify some risk ratings – particularly in the social and economic context. This will require some forward planning on the best indicators to measure and then commensurate investment to measure these indicators over time. While a clear advantage of the TARA approach is to be able to go back periodically to re-evaluate the risk consequences and likelihoods, the ability to add value at each subsequent review will depend on the provision of improved data and information to underpin decision making using the extensive evidence presented in Appendix C and D as a baseline.

7 References

Beeton RJS., Buxton CD., Cutbush GC., Fairweather PG., Johnston EL., Ryan R. 2012, 'Report of the independent scientific audit of marine parks in New South Wales'. NSW Department of PrimaryIndustries and Office of Environment and Heritage: NSW.

Feary, S. (2015) Sea Countries of New South Wales: benefits and threats to Aboriginal people's connections with the marine estate.

Marine Estate Management Authority (2013), Managing the NSW Marine Estate: Purpose, Underpinning Principles and Priority Setting, NSW Marine Estate Management Authority, November (http://www.marine.nsw.gov.au/__data/assets/pdf_file/0004/498604/Managing-Marine-Estate.pdf).

Marine Estate Management Authority (2015a) Threat and Risk Assessment Framework for the NSW Marine Estate. NSW Marine Estate Management Authority, Sydney.

Marine Estate Management Authority (2015b) 'Background to the Hawkesbury Shelf Marine bioregion assessment Report 1 – community engagement'.

Marine Estate Management Authority (2015c) 'Hawkesbury Shelf Marine Bioregion assessment. Report 2 - Background environmental information'.

Schnierer, S. (2015) Peer Review of Draft Report "Sea countries of New South Wales: benefits and threats to Aboriginal people's connections to the marine environment" for the Marine Estate Expert Knowledge Panel. Suffolk Park, 7pp.

Sweeney Research (2014). Marine Estate Community Survey – Final Report. Sydney, 395 pp.

Vanderkooi Consulting (2015) 'Social and economic background information report on the NSW marine estate'.

Appendix A Goals, Objectives, Consequence and Likelihoods

Marine Estate Management Authority

Goals, Objectives, Consequences and Likelihoods

Hawkesbury Shelf Marine Bioregion Threat and Risk Assessment

1. Introduction

The risk management standard (AS/NZS ISO 31000:2009 (Risk management – principles and guidelines)) notes that risk assessment involves the consideration of the causes and sources of risk to achieving the objectives of the "organisation" and its stakeholders; in this case the objective is to enhances and conserve biodiversity for the Hawkesbury Shelf marine bioregion. It also includes a consideration of the magnitude of the potential consequences and the likelihood that those consequences will occur given current management controls.

The NSW Marine Estate Management Authority (MEMA) has developed environmental, social and economic risk goals, objectives and consequence and likelihood tables for use in the risk assessment phase for the bioregion's threat and risk assessment (TARA).

Definitions of 'insignificant', 'minor', 'moderate', 'major' and 'catastrophic' consequences referred to in the tables in Section 2 are given in relation to each objective. Definitions of 'rare', 'unlikely', 'possible', 'likely' and 'almost certain' likelihood levels are given in Section 3 and relate to all objectives. These definitions will ensure that consequence and likelihood terminology is used consistently and transparently when undertaking threat and risk assessments for the NSW marine estate at any scale.

The goals and objectives given below have been designed for threat and risk assessment purposes only and, while they are broadly consistent with related Government objectives as expressed in existing legislation and policy documents, they do not represent policy or management objective statements.

2. Legislative and Policy Setting

The goals and objectives have been designed to be consistent with:

- the objects and requirements for threat and risk assessment (TARA) in the *Marine Estate Management Act 2014* (MEM Act)
- the objects of other relevant legislation relating to clean waters, biodiversity and coastal processes as outlined in Attachment 1.
- the vision for the marine estate outlined in MEMA's Principles Paper
- the purpose and objectives of the Hawkesbury Shelf Marine Bioregion project

TARA Requirements in MEM Act

The TARA requirements are outlined in the objects and in section 20 of the MEM Act. The objects of the MEM Act are:

(a) to provide for the management of the marine estate of NSW consistent with the principles of ecologically sustainable development in a manner that:
  (i) promotes a biologically diverse, healthy and productive marine estate, and
  (ii) facilitates:
  - economic opportunities for the people of New South Wales, including opportunities for regional communities, and
  - the cultural, social and recreational use of the marine estate, and
  - the maintenance of ecosystem integrity, and
  - the use of the marine estate for scientific research and education,

(b) to promote the co-ordination of the exercise, by public authorities, of functions in relation to the marine estate,
(c) to provide for the declaration and management of a comprehensive system of marine parks and aquatic reserves.

The requirements for threat and risk assessment outlined in Section 20 of the MEM Act are:
(a) to identify threats to the environmental, economic and social values of the marine estate, and
(b) to assess the risks associated with those identified threats, and
(c) to inform marine estate management decisions by prioritising those threats and risks according to the level of impact on the values derived from the marine estate.

Vision for the NSW marine estate

The vision as stated in MEMA's Principles Paper (MEMA, 2013) is for *a healthy coast and sea, managed for the greatest well-being of the community, now and into the future*.

Objective of the Hawkesbury Shelf Marine Bioregion Project

As stated in the approved project plan for the project, the purpose and objective of the project are to:

> *"develop recommendations to enhance and conserve biodiversity in the Hawkesbury Shelf marine bioregion including:*
>
> - *managing threats to marine biodiversity*
> - *managing existing aquatic reserves and other identified priority sites*
> - *exploring opportunities, if any, for a potential new marine park."*

There is also a commitment to deliver the following information:

1. Identification of economic, social, and environmental benefits derived by the community from the bioregion.
2. Assessment and prioritisation of threats and risks to social, economic, and environmental benefits in the bioregion.
3. Assessment of a range of marine biodiversity conservation management options, and consideration of CAR principles, to manage threats, address gaps, and maximise community benefit including:
    - assessment of the role and management of existing aquatic reserves and other sites where the community has requested increased protection; and
    - recommendations to enhance and conserve marine biodiversity in the bioregion, while achieving balanced outcomes including opportunities for fishing, boating, education, research, diving and a range of passive uses.

3. Risk goals, objectives and consequence and likelihood tables

3.1 Environmental goal, objectives and consequence tables

Overall environmental goal: To enhance and conserve biodiversity of the Hawkesbury Shelf marine bioregion

Environmental objective 1: To maintain the quality of estuarine and marine waters to ensure maintenance of environmental processes

This objective is consistent with the objects of the *Protection of the Environment Operations Act 1997* (see Attachment 1).

Consequence level	Consequence of impacts on clean waters
Insignificant	No measurable negative impacts on water quality are or will be possible against natural variations
Minor	Barely measurable negative impacts on water quality outside of natural variation are or will be evident, and any impacts identified have not or will not substantially affect environmental processes
Moderate	Measurable and on-going negative impacts on water quality are or will be evident in one or more locations. Nevertheless, the level, duration and/or the proportion of area affected have not or will not influence the overall recovery capacity, and the environmental processes in most of the affected location(s) are or will be maintained
Major	Substantial measurable and on-going negative impacts on water quality are or will be evident in one or more locations, and the level, duration and/or the proportion of area is such that environmental processes are or will be adversely affected
Catastrophic	Substantial measurable on-going negative impacts on water quality in one or more locations are or will be evident that are or will endanger environmental processes and their underlying ecological assets in the long-term

Environmental objective 2: To conserve estuarine and marine habitats and biotic assemblages, and ensure their ecologically sustainable use.

This objective is consistent with the objects of the MEM Act and the *Fisheries Management Act 1994* (see Attachment 1).

Consequence Level	Consequence of impacts on environmental assets (habitats and biotic assemblages)
Insignificant	No measurable negative impacts on habitats and/or biotic assemblages are or will be evident against natural variations
Minor	Barely measurable negative impacts on habitats and/or biotic assemblages are or will be evident compared to total habitat area or abundance of biota against natural variations
Moderate	Measurable and on-going negative impacts on habitats and/or biotic assemblages are or will be evident. Nevertheless, both the level and the percentage of habitats and/or biotic assemblages affected have not or will not influence their overall recovery capacity, and a change in the overall trophic/community structure isn't and will not be evident
Major	Substantial measureable and on-going negative impacts on habitats and/or biotic assemblages are or will be evident, and the proportion of habitats and/or biotic assemblages affected will influence the recovery capacity of the habitats and/or biotic assemblages, with some clear shifts in the overall trophic/community structure and function
Catastrophic	The level of habitat and/or biotic assemblages negatively affected endangers their long-term survival, and will result in extreme changes to the region's trophic/community structure as well as the function of the remaining habitat and/or biotic assemblages.

Environmental objective 3: To conserve listed threatened and protected estuarine and marine species.

This objective is consistent with the objects of the *Fisheries Management Act 1994* (see Attachment 1).

Consequence Level	Consequence of impacts on threatened and protected species
Insignificant	No measurable negative impacts on threatened or protected species are or will be evident against natural variation
Minor	Barely measurable negative impacts on threatened or protected species are or will be evident against natural variation. Nevertheless, there are either no substantial negative impacts or only extremely few mortalities within 5-10 years, and there is not and will not be a measurable effect on local population status of protected species or recovery of threatened species
Moderate	Many individuals of a threatened or protected species are or will be measurably negatively affected. Nevertheless, no on-going impact on local dynamics or overall number of individuals is or will be evident, and the impact has not or will not significantly affect population status of protected species or recovery of already threatened species.
Major	Substantial measurable and on-going negative impacts that are or will affect the number of individuals of protected species and recovery of already threatened species
Catastrophic	The ongoing level of mortality has or will generate significant additional declines to already threatened or protected species leading to potential local extinction in NSW

2.2 Social goal, objective and consequence table

Overall social goal: To enhance and conserve biodiversity of the Hawkesbury Shelf marine bioregion for the greatest well-being of the community now and into the future

Social objective: To provide for cultural, social and recreational use of the marine estate

This objective is consistent with the objects of the MEM Act.

Consequence Level	Consequence of impacts on social benefits
Insignificant	No discernible negative impacts on social benefits are or will be evident at a bioregion-wide scale or to local communities
Minor	Barely discernible and/or temporary negative impacts are or will be evident on social benefits at a bioregion-wide scale or to local communities
Moderate	Measurable and ongoing negative impacts are or will be evident on social benefits enjoyed by the NSW community at a bioregion-wide scale, or major negative impacts on the social benefits derived in one location
Major	Substantial measurable and ongoing negative impacts are or will be evident on social benefits enjoyed by communities in multiple locations or at a bioregion-wide scale, or a catastrophic negative impact on social benefits at a local level
Catastrophic	Substantial measurable on-going negative impacts on a very large proportion of the NSW community in the bioregion are or will be affected, and the long-term social benefits expected from the NSW marine estate are endangered either permanently or over the long term

2.3 Economic goal, objective and consequence table

Overall economic goal: To enhance and conserve biodiversity of the Hawkesbury Shelf marine bioregion for the greatest well-being of the community now and into the future

Economic objective: To provide for economic opportunities for the people of NSW, including opportunities for regional communities

This objective is consistent with the objects of the MEM Act.

Consequence Level	Consequence of impacts on economic benefits
Insignificant	No measurable negative impacts on economic benefits are or will be evident at a bioregion-wide scale or to local communities
Minor	Barely measurable and/or temporary negative impacts on the economic benefits at either a local or up to the bioregion-wide scale either are, or unlikely to be, evident
Moderate	Measurable and on-going negative impacts are or will be evident on the economic benefits enjoyed by the NSW community at a bioregion-wide scale, or major negative impacts on the economic benefits derived in one location
Major	Substantial measurable on-going negative impacts are or will be evident on the economic benefits enjoyed by communities in multiple locations or a bioregion-wide scale, or a catastrophic negative impact on economic benefits at a local level
Catastrophic	Substantial measurable on-going impacts are, or are almost certain to occur, at a level that would terminate delivery of the majority of economic benefits expected from the NSW marine estate in the bioregion either permanently or in the long term

3. Likelihood definitions relevant to all objectives (environmental, social and economic)

Likelihood level	Likelihood of impacts in the bioregion
Rare	Never reported in this situation, but still plausible within the timeframe (< 5%)
Unlikely	Uncommon, but has been known to occur elsewhere. Expected to occur in the bioregion only in specific circumstances within the timeframe (5-30%)
Possible	Some clear evidence exists to suggest this is possible in this situation within the timeframe (30-50%)
Likely	Expected to occur in this situation within the timeframe (50-90%)
Almost certain	A very large certainty that this will occur in this situation within the timeframe (>90%)

Attachment 1: Other legislation relevant to the risk goals and objectives for the Hawkesbury Shelf Marine Bioregion.

Protection of the Environment Operations Act 1997

The objects of this Act are as follows:
(a) to protect, restore and enhance the quality of the environment in New South Wales, having regard to the need to maintain ecologically sustainable development,
(b) to provide increased opportunities for public involvement and participation in environment protection,
(c) to ensure that the community has access to relevant and meaningful information about pollution,
(d) to reduce risks to human health and prevent the degradation of the environment by the use of mechanisms that promote the following:
  (i) pollution prevention and cleaner production,
  (ii) the reduction to harmless levels of the discharge of substances likely to cause harm to the environment,
  (iia) the elimination of harmful wastes,
  (iii) the reduction in the use of materials and the re-use, recovery or recycling of materials,
  (iv) the making of progressive environmental improvements, including the reduction of pollution at source,
  (v) the monitoring and reporting of environmental quality on a regular basis,
(e) to rationalise, simplify and strengthen the regulatory framework for environment protection,
(f) to improve the efficiency of administration of the environment protection legislation,
(g) to assist in the achievement of the objectives of the *Waste Avoidance and Resource Recovery Act 2001*.

Fisheries Management Act 1994

The objects of this Act are as follows:
(1) The objects of this Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations.
(2) In particular, the objects of this Act include:
  (a) to conserve fish stocks and key fish habitats, and
  (b) to conserve threatened species, populations and ecological communities of fish and marine vegetation, and
  (c) to promote ecologically sustainable development, including the conservation of biological diversity,and, consistently with those objects:
  (d) to promote viable commercial fishing and aquaculture industries, and
  (e) to promote quality recreational fishing opportunities, and
  (f) to appropriately share fisheries resources between the users of those resources, and
  (g) to provide social and economic benefits for the wider community of New South Wales, and
  (h) to recognise the spiritual, social and customary significance to Aboriginal persons of fisheries resources and to protect, and promote the continuation of, Aboriginal cultural fishing.

Section 220A - Threatened species conservation objects of Part are as follows:
(a) to conserve biological diversity of fish and marine vegetation and promote ecologically sustainable development and activities,
(b) to prevent the extinction and promote the recovery of threatened species, populations and ecological communities of fish and marine vegetation,
(c) to protect the critical habitat of those threatened species, populations and ecological communities that are endangered,
(d) to eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities of fish and marine vegetation,
(e) to ensure that the impact of any action affecting threatened species, populations and ecological communities of fish and marine vegetation is properly assessed,
(f) to encourage the conservation of threatened species, populations and ecological communities of fish and marine vegetation by the adoption of measures involving co-operative management.

Coastal Protection Act 1979

The objects of this Act are to provide for the protection of the coastal environment of the State for the benefit of both present and future generations and, in particular:
(a) to protect, enhance, maintain and restore the environment of the coastal region, its associated ecosystems, ecological processes and biological diversity, and its water quality, and
(b) to encourage, promote and secure the orderly and balanced utilisation and conservation of the coastal region and its natural and man-made resources, having regard to the principles of ecologically sustainable development, and

(c) to recognise and foster the significant social and economic benefits to the State that result from a sustainable coastal environment, including:
  (i) benefits to the environment, and
  (ii) benefits to urban communities, fisheries, industry and recreation, and
  (iii) benefits to culture and heritage, and
  (iv) benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water, and
(d) to promote public pedestrian access to the coastal region and recognise the public's right to access, and
(e) to provide for the acquisition of land in the coastal region to promote the protection, enhancement, maintenance and restoration of the environment of the coastal region, and
(f) to recognise the role of the community, as a partner with government, in resolving issues relating to the protection of the coastal environment, and
(g) to ensure co-ordination of the policies and activities of the Government and public authorities relating to the coastal region and to facilitate the proper integration of their management activities, and
(h) to encourage and promote plans and strategies for adaptation in response to coastal climate change impacts, including projected sea level rise, and
(i) to promote beach amenity.

National Parks and Wildlife Act 1974

The objects of this Act are as follows:

(a) the conservation of nature, including, but not limited to, the conservation of:

(i) habitat, ecosystems and ecosystem processes, and

(ii) biological diversity at the community, species and genetic levels, and

(iii) landforms of significance, including geological features and processes, and

(iv) landscapes and natural features of significance including wilderness and wild rivers,

(b) the conservation of objects, places or features (including biological diversity) of cultural value within the landscape, including, but not limited to:

(i) places, objects and features of significance to Aboriginal people, and

(ii) places of social value to the people of New South Wales, and

(iii) places of historic, architectural or scientific significance,

(c) fostering public appreciation, understanding and enjoyment of nature and cultural heritage and their conservation,

(d) providing for the management of land reserved under this Act in accordance with the management principles applicable for each type of reservation.

Threatened Species Conservation Act 1995

The objects of the Act are (s.3):

(a) to conserve biological diversity and promote ecologically sustainable development, and
(b) to prevent the extinction and promote the recovery of threatened species, populations and ecological communities, and
(c) to protect the critical habitat of those threatened species, populations and ecological communities that are endangered, and
(d) to eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities, and
(e) to ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed, and
(f) to encourage the conservation of threatened species, populations and ecological communities by the adoption of measures involving co-operative management.

Sydney Harbour Regional Environmental Plan (Sydney Harbour Catchment) 2005

The aims of the plan are:

(1) This plan has the following aims with respect to the Sydney Harbour Catchment:
  (a) to ensure that the catchment, foreshores, waterways and islands of Sydney Harbour are recognised, protected, enhanced and maintained:
    (i) as an outstanding natural asset, and
    (ii) as a public asset of national and heritage significance,
    for existing and future generations,
  (b) to ensure a healthy, sustainable environment on land and water,
  (c) to achieve a high quality and ecologically sustainable urban environment,
  (d) to ensure a prosperous working harbour and an effective transport corridor,
  (e) to encourage a culturally rich and vibrant place for people,
  (f) to ensure accessibility to and along Sydney Harbour and its foreshores,
  (g) to ensure the protection, maintenance and rehabilitation of watercourses, wetlands, riparian lands, remnant vegetation and ecological connectivity,
  (h) to provide a consolidated, simplified and updated legislative framework for future planning.

(2) For the purpose of enabling these aims to be achieved in relation to the Foreshores and Waterways Area, this plan adopts the following principles:
  (a) Sydney Harbour is to be recognised as a public resource, owned by the public, to be protected for the public good,
  (b) the public good has precedence over the private good whenever and whatever change is proposed for Sydney Harbour or its foreshores,
  (c) protection of the natural assets of Sydney Harbour has precedence over all other interests.

Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River 1997

The aim of this plan is to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context.

State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011

The aims of this Policy are:
(a) to provide for healthy water catchments that will deliver high quality water while permitting development that is compatible with that goal, and
(b) to provide that a consent authority must not grant consent to a proposed development unless it is satisfied that the proposed development will have a neutral or beneficial effect on water quality, and
(c) to support the maintenance or achievement of the water quality objectives for the Sydney drinking water catchment.

State Environmental Planning Policy No.14 – Coastal Wetlands

The aim of this policy is to ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the State

State Environmental Planning Policy No71 – Coastal Protection

The aims of this policy are:

(a) to protect and manage the natural, cultural, recreational and economic attributes of the New South Wales coast, and
(b) to protect and improve existing public access to and along coastal foreshores to the extent that this is compatible with the natural attributes of the coastal foreshore, and
(c) to ensure that new opportunities for public access to and along coastal foreshores are identified and realised to the extent that this is compatible with the natural attributes of the coastal foreshore, and
(d) to protect and preserve Aboriginal cultural heritage, and Aboriginal places, values, customs, beliefs and traditional knowledge, and
(e) to ensure that the visual amenity of the coast is protected, and
(f) to protect and preserve beach environments and beach amenity, and
(g) to protect and preserve native coastal vegetation, and
(h) to protect and preserve the marine environment of New South Wales, and
(i) to protect and preserve rock platforms, and

(j) to manage the coastal zone in accordance with the principles of ecologically sustainable development (within the meaning of section 6 (2) of the Protection of the Environment Administration Act 1991), and
(k) to ensure that the type, bulk, scale and size of development is appropriate for the location and protects and improves the natural scenic quality of the surrounding area, and
(l) to encourage a strategic approach to coastal management.

Appendix B Workshops

B1 Workshops and Participants

Interactive workshops were held in Sydney on 20 August for the Environmental Assessment and on 26 and 27 August for the Social and Economic Assessment.

The participants for the workshops included:

- The external Risk Assessment Facilitator or RAF (also the author of this report)
- Representatives from the MEEKP
- Representatives from the Department of Primary Industries
- Representatives from the Office of Environment and Heritage
- Representatives from the Department of Planning and Environment
- Representatives from Transport for NSW
- Appointed independent experts representing environmental (x2), social and economic expertise.

The Social and Economic workshop addressed both the statewide and Hawkesbury Shelf Marine Bioregional assessment, noting the matrices and findings presented in this report in Appendix D is for the Hawkesbury Shelf only.

B2 Pre-Workshop Process

A pre-workshop information session was held with the independent experts and agency staff on 22 July in Sydney (and a subsequent teleconference was held with those experts unable to attend this meeting).

As part of this session, the TARA process was discussed, clarifications sought and opportunities and recommendations for improvement were captured. A key agreement of this pre-workshop approach was that the participants (excepting the MEEKP representatives and RAF) would seek to undertake a preliminary risk attribution that could be brought to the workshop for discussion.

B3 During the Workshop

In the main, the workshops consisted of the RAF going through each of the threat and benefit matrices with the participants.

Emphasis was placed on those risk cells that were highlighted by agencies or the independent experts as part of their initial risk attribution as ‘High’ or ‘Moderate’ risks. Additional discussion was facilitated about the background information and other evidence for those items where consensus between participants was not forthcoming. Where consensus was not reached on a risk score, this was captured for further discussion post-workshop.

The workshop process also led to minor amendments to the benefit and threat categories across both processes as outlined in Section 3 and 4 later in this report which were documented and agreed by the participants in session where possible. In some cases, this led to the need for reviewing risk scores by some participants which was conducted out of session.

Spatial, temporal and confidence ratings were provided specifically for those threats that contained High or Moderate Risks to one or more benefits.

B4 Post Workshop Process

Workshop proceedings (in the form of the completed TARA matrices) were circulated to the participants to review and for further consideration on the context of the justifications and evidence for ratings.

Teleconferences were held following the workshops to resolve risk ratings where consensus between participants was not reached in session and to review any new risk ratings that were inserted out of session.

Appendix C Environmental Risk Matrices

Appendix D Social and Economic Matrices

Appendix E Glossary of Terms

Glossary of terms

These terms are used consistently by the Authority in the delivery of their priority actions and initiatives within the **Schedule of Works**

Asset - the physical features of the marine estate, but does not include people. There are three main types of assets:

- environmental assets – the natural attributes, components and living resources of the marine estate,
- cultural assets – structures, places or associations that form or contribute to cultural identity,
- infrastructure assets - functional structures installed for people to use and interact with the marine estate.

Benefit – see 'community benefit'.

Community benefit - anything that contributes to the wellbeing of the community. There are three separate categories of community benefits: economic, social and environmental benefits. Many community benefits are based on what people think is important (what they value). A community benefit of the marine estate could be:

- swimming at the beach,
- boating in an estuary,
- doing something as a hobby (e.g. fishing, kayaking, surfing, bird watching, etc.),
- running a business (e.g. whale watching business, charter fishing, commercial fishing, etc.),
- clean waters and marine biodiversity.

The *Marine Estate Management Act 2014* uses the term 'community value' for this.

Community value – the term used by the *Marine Estate Management Act 2014* for 'community benefit'.

Community wellbeing - the overall aggregate of economic, social and environmental benefits.

Consequence – the result of something happening, including a change in circumstances affecting objectives. It can be certain or uncertain and have positive or negative effects on objectives. A consequence can be expressed qualitatively or quantitatively.

Cumulative impact – the impact (positive or negative) resulting from the effects of one or more impacts, and the interactions between those impacts, added to other past, present and reasonably foreseeable future pressures.

Cultural use - the use of the marine estate to demonstrate or perform skills, arts, beliefs and customs and to pass these on from one generation to the next.

Ecological - the relationship between organisms and their environment.

Economic - the production, distribution, and use of income, wealth, and commodities.

Economic benefits - benefits derived by the community from the marine estate that are of an economic or financial nature.

Effect - a deviation from the measured status. Effects can be positive or negative.

Environmental benefit – benefits derived by the community from the marine estate's environmental assets.

Impact - the outcome of the direct or indirect effect of activities and natural events on the assets or values of the environmental, social or economic components (i.e. pressure + response).

Likelihood - the chance of something happening.

Marine estate - as defined in the *Marine Estate Management Act 2014* means:

- the coastal waters of New South Wales within the meaning of Part 10 of the *Interpretation Act 1987*
- estuaries (being any part of a river whose level is periodically or intermittently affected by coastal tides) up to the highest astronomical tide
- lakes, lagoons and other partially enclosed bodies of water that are permanently, periodically or intermittently open to the sea
- coastal wetlands (including saltmarsh, mangroves and seagrass), lands immediately adjacent to, or in the immediate proximity of, the coastal waters of New South Wales that are subject to oceanic processes (including beaches, dunes, headlands and rock platforms)
- any other place or thing declared by the regulations to be the marine estate
- but does not include any place or thing declared by the regulations not to be the marine estate.

Open access resource - resources that can be accessed by anyone at any time.

Opportunity - a time, set of circumstances or activity that makes it possible to improve community wellbeing.

Over-exploitation - harvesting species or resources at rates faster than natural populations or resources can recover.

Residual risk – the risk remaining after taking current management efforts into account (these efforts are called risk treatment or risk management).

Resilience - the maximum change (or disturbance) that can occur before a population or system can no longer resist it or recover from it. The change (or disturbance) can be:

- "pulse" – an acute, short-term change that results in a temporary response
- "press" – a sustained or chronic change that could cause a long-term response
- "catastrophic" – a major, long-term change from which a population or system is unlikely to recover.

Resource use conflict - disagreements and disputes over access to and control of natural resources.

Risk - the chance of something happening that will have an impact on achieving environmental, social or economic objectives.

Risk analysis – a process to comprehend the nature or level of risk.

Risk assessment - overall process of risk identification, risk analysis and risk evaluation.

Risk context – the internal and external environment in which the government and broader community seek to achieve their objectives.

Risk criteria - terms of reference against which the significance of a risk is evaluated. They are based on objectives and risk context and can be derived from standards, laws, policies and other requirements.

Risk evaluation - the process for deciding whether the risk and its magnitude are acceptable or tolerable. The evaluation does this by comparing the results of risk analysis to agreed criteria.

Risk identification - process of finding, recognising and describing risks. It involves the identification of risk sources, events, their causes and potential consequences. It can draw on historical data, analysis, informed and expert opinions, and surveys of stakeholder's needs.

Risk level - magnitude of a risk or combination of risks, generally expressed in terms of the combination of consequences and their likelihood.

Risk management - coordinated activities to direct and control threats with regard to risk.

Risk management framework - a set of components that provides the foundations and management arrangements for designing, implementing, monitoring, reviewing and continually improving risk management.

Risk owner – the agency or stakeholder with the accountability and authority to manage a risk.

Risk perception – a stakeholder's view on a risk.

Risk treatment – a process to modify the risk (e.g. avoiding it, removing the source, changing the likelihood or consequences, sharing the risk or retaining and managing the risk by informed decisions). Management controls introduced by government are examples of risk treatments.

Social - of or relating to the life and relations of people in a community.

Social benefits – the social and relational benefits the community derives from the marine estate.

Stakeholder – a person, organisation (including agencies) that can affect, be affected by, or perceive themselves to be affected by a decision or activity.

Threat - a broad activity, event or process that poses a potential level of risk to community wellbeing. Threats often affect multiple benefits and each benefit is invariably affected by multiple threats. Threats have also been called 'risk sources' in some publications.

Trade-off - the relinquishment of one benefit or value for another that is regarded as more desirable.

Value – see 'community value'.

Published by NSW Government.

TRIM reference number INT14/114141

BMT WBM Bangalow
6/20 Byron Street, Bangalow 2479
Tel +61 2 6687 0466 Fax +61 2 66870422
Email bmtwbm@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Brisbane
Level 8, 200 Creek Street, Brisbane 4000
PO Box 203, Spring Hill QLD 4004
Tel +61 7 3831 6744 Fax +61 7 3832 3627
Email bmtwbm@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Denver
8200 S. Akron Street, #B120
Centennial, Denver Colorado 80112 USA
Tel +1 303 792 9814 Fax +1 303 792 9742
Email denver@bmtwbm.com
Web www.bmtwbm.com

BMT WBM London
International House, 1st Floor
St Katharine's Way, London E1W 1AY
Email london@bmtwbm.co.uk
Web www.bmtwbm.com

BMT WBM Mackay
PO Box 4447, Mackay QLD 4740
Tel +61 7 4953 5144 Fax +61 7 4953 5132
Email mackay@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Melbourne
Level 5, 99 King Street, Melbourne 3000
PO Box 604, Collins Street West VIC 8007
Tel +61 3 8620 6100 Fax +61 3 8620 6105
Email melbourne@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Newcastle
126 Belford Street, Broadmeadow 2292
PO Box 266, Broadmeadow NSW 2292
Tel +61 2 4940 8882 Fax +61 2 4940 8887
Email newcastle@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Perth
Level 3, 20 Parkland Road, Osborne, WA 6017
PO Box 1027, Innaloo WA 6918
Tel +61 8 9328 2029 Fax +61 8 9486 7588
Email perth@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Sydney
Suite G2, 13-15 Smail Street, Ultimo, Sydney 2007
Tel +61 2 8960 7755 Fax +61 2 8960 7745
Email sydney@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Vancouver
Suite 401, 611 Alexander Street
Vancouver British Columbia V6A 1E1 Canada
Tel +1 604 683 5777 Fax +1 604 608 3232
Email vancouver@bmtwbm.com
Web www.bmtwbm.com