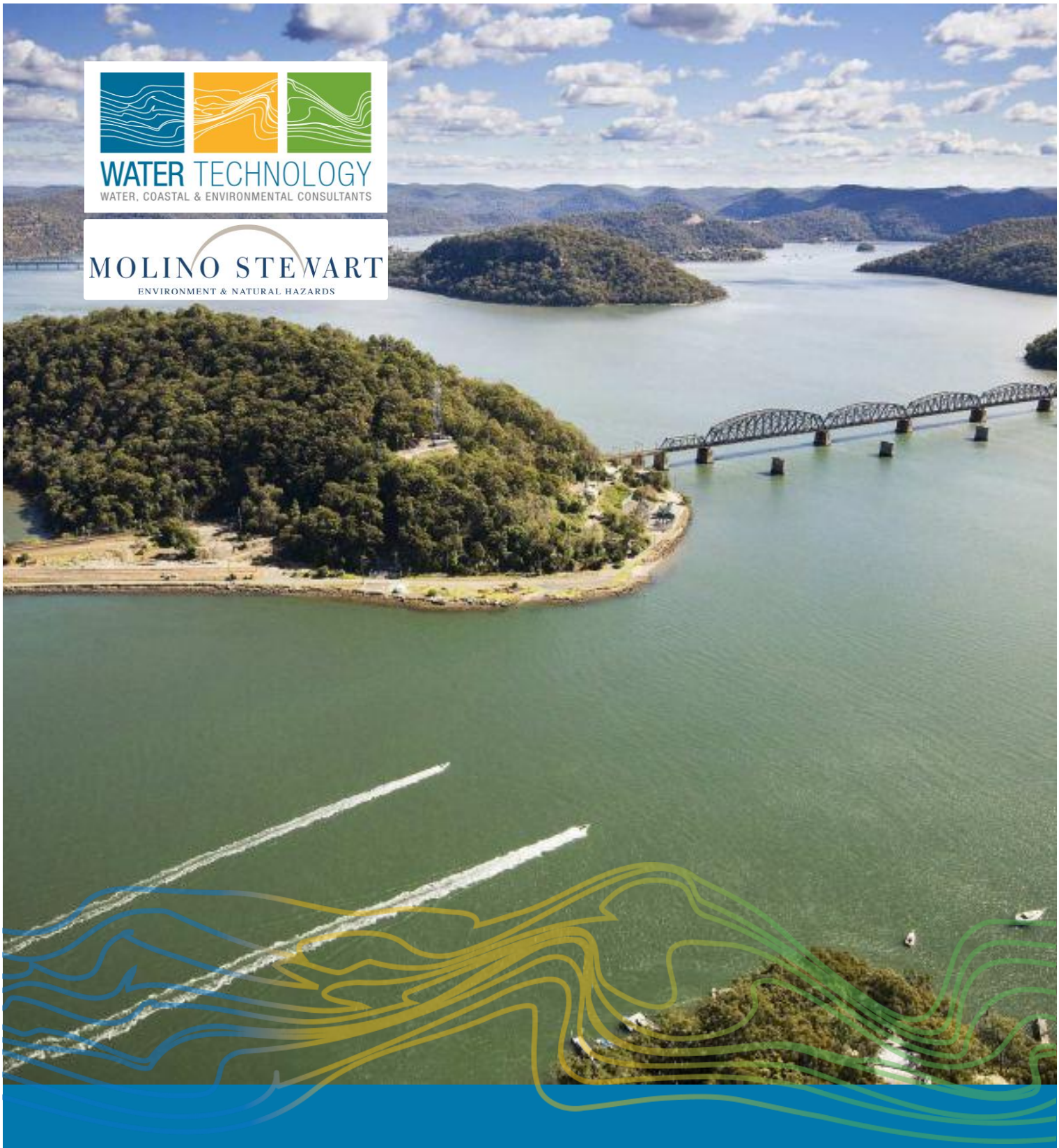

WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

MOLINO STEWART
ENVIRONMENT & NATURAL HAZARDS

Final Report

Hawkesbury-Nepean River System Coastal Management Program Stage 1 Scoping Study

Prepared for Hornsby Shire Council

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EXECUTIVE SUMMARY

The Hawkesbury-Nepean River system is a major social, environmental and economic asset for the state of New South Wales. This extensive estuary system encompasses the Hawksbury-Nepean River, Pittwater, Brisbane Water and Broken Bay, which span the Greater Sydney and Hunter - Central Coast regions. Together, these provide a stunning natural environment, areas of cultural significance, a multitude of social and recreational benefits, and are a key contributor to the regional economy.

In accordance with the NSW Coastal Management Framework, management of the estuary system and its tributaries will be guided by a Coastal Management Program (CMP). The six (6) councils that border the tidal waterways of the system have agreed to work together through Stage 1 of an integrated, whole of system CMP. The councils are:

- Central Coast Council
- Hawkesbury City Council
- The Hills Shire Council
- Hornsby Shire Council
- Ku-ring-gai Council
- Northern Beaches Council

The purpose of the CMP is to set the long-term strategy for the coordinated management of the system and its catchment. The CMP seeks to achieve the objectives of the *Coastal Management Act* through a program that will identify coastal management issues, pressures, and risks - and the actions required to address these issues in a strategic and integrated way.

This Scoping Study represents the first of five stages in the CMP Process. As per the requirements of the NSW Coastal Management Manual, this study has reviewed the history of managing the river system, developed a shared understanding of the current situation, and identified the strategic path of the remaining CMP stages, which include:

- Stage 2: A detailed assessment of risks, vulnerabilities and opportunities;
- Stage 3: Identification and evaluation of management actions;
- Stage 4: Preparation, exhibition and adoption of the CMP; and
- Stage 5: Implementation, monitoring and evaluation

Values of the Hawkesbury-Nepean River System

The Hawkesbury-Nepean River system includes a diverse range of natural environments, including aquatic ecosystems that span both marine and freshwater, and terrestrial ecosystems that include the riparian zone and catchment systems. The system possesses significant biodiversity and conservation value, and contains a vast array of freshwater and coastal wetlands - including mangrove forests, seagrass beds, and saltmarshes. These habitats support a diverse assemblage of ecosystems, including a number of endangered ecological communities and over 130 vulnerable and threatened species.

Land use across the wider Hawkesbury-Nepean catchment is diverse. The majority of the catchment (more than 70%) comprises undeveloped bushland and national parks, with agricultural use and forestry also prominent across the upper catchment. Areas of high intensity urban development are common across the lower catchment, particularly within the Greater Sydney and Central Coast regions, with isolated pockets in the upstream catchments. The Hawkesbury-Nepean Catchment also provides drinking water for 5 million people across Greater Sydney, and the upstream catchment also provides for local rural water supplies (for example Goulburn, Bowral and Lithgow).

The system and its catchment provide spectacular scenic amenity and a vast array of recreational opportunities to both the local community and its visitors. It contains some of the most popular and heavily trafficked waterways in the state, largely as a result of its proximity to Sydney and Central Coast. There are over 100,000 boat licence holders in the Hawkesbury River, Pittwater and Brisbane Water region and over 40,000 registered recreational vessels.

The estuary is also a significant contributor to the “blue economy” of the Greater Sydney and Central Coast regions. It supports the aquaculture (oysters farming), commercial fishing and tourism industries, and provides substantial economic value in the form of its ecosystem services.

Pressures and Threats Facing the Estuary

A first-pass risk assessment has been undertaken as part of this Scoping Study, which has identified that the river system is facing a number of pressures that threaten its environmental, social and economic values. Many of these threats will increase over the coming decades due to population growth within the catchment and the impacts of climate change. These pressures range from smaller localised issues, up to larger scale, system-wide threats that will require a coordinated and collaborative management approach.

Coastal inundation and sea level rise represent a significant issue over future planning horizons for a number of low-lying communities and critical infrastructure across the Brisbane Water, Pittwater and the Hawkesbury River estuaries. Many of these communities will be exposed to permanent inundation, or an increased frequency of temporary inundation associated king tides and coastal and catchment flooding.

Catchment runoff and urban stormwater discharge are a major source of water quality issues at various locations across the study area. Water quality has also historically been affected by runoff associated with agricultural activities across the catchment and point source discharges from waste water treatment facilities. These water quality issues across the system can affect estuary health and aquatic ecosystems, recreational amenity and the local aquaculture industry.

Other key threats include the disturbance of riparian and aquatic habitat, and the presence of invasive species and diseases. Blooms of harmful algal species have historically occurred across both the upper and lower Hawkesbury River, with associated environmental, social and economic impacts.

The study has also identified a number of emerging pressures that will increasingly affect the system over the coming decades. The Greater Sydney Regional Plan identifies a number of major development areas within the Hawkesbury-Nepean catchment that will house a significant population increase over the next twenty years. This will also include substantial industrial and commercial precincts – including the Western Sydney International Airport. This intensification of urban development across the catchment will result in a significant increase in the urban and industrial discharges into the river system.

Another major challenge identified by the project stakeholders is the lack of coordination across the river system and catchment between the estuary councils, catchment councils, and state government agencies. This has historically resulted significant jurisdictional ambiguity across governance bodies, and a reduced ability to address system-wide issues and threats.

The Benefits of a CMP

The stakeholder engagement activities undertaken as part of this scoping study demonstrated significant support for the development of a CMP across a broad range of local and state government agencies.

The CMP will provide an opportunity to develop a strategic, long-term approach to estuary and catchment management, and improve coordination across local governments and state government agencies. It provides an opportunity to link with local, regional and state planning initiatives, as well as programs and strategies across the upper catchment. Through this approach, the CMP can improve river health across not just the estuarine reach of the study area - but across the waterways and contributing catchment of the wider Hawkesbury-Nepean River system.

The CMP will provide a robust and defensible platform to secure funding from the NSW Government's Coastal and Estuary Grants Program and other potential funding sources, and support the implementation of projects that will provide tangible benefits to the local community right across the catchment. This is vital to ensure safe and sustainable access to the river system, protect public assets from current and future hazards, and maintain healthy ecosystems and biodiversity.

The Scope of the CMP

The project steering committee has decided to adopt a system-wide approach to the CMP, in recognition of the fact that important physical and ecological processes extend across the waterways, catchment and foreshores of the Hawkesbury-Nepean River system. The study area of the CMP therefore includes the Hawkesbury-Nepean River system, the Brisbane Water Estuary, the Pittwater Estuary and

Broken Bay - as well as the wider contributing Hawkesbury-Nepean catchment.

This system-wide approach will provide a vehicle for the coordinated and strategic management of the river system, and create a program that can more effectively and efficiently address catchment scale issues, threats & risks. This approach can also foster alignment with regional and strategic planning initiatives.

Furthermore, there may be significant cost savings associated with this approach, compared to developing multiple CMPs for the each of the individual estuaries (Brisbane Water, Pittwater, and the Hawkesbury River). The system-wide CMP can harness economies of scale and provide a platform for attracting government and/or private funds to address larger (catchment scale) issues and threats.

Governance

Governance of the estuary is multi-layered, with the waterways and foreshores owned and managed by a wide variety of stakeholders across multiple levels of government.

This scoping study has recommended a governance structure for the remaining stages of the CMP. The program should be led by a project steering committee, which will be comprised of the six estuary councils and the Department of Planning, Industry and Environment (DPIE). The steering committee will be supported by a series of advisory bodies comprising of relevant state government agencies, councils from the upper catchment, indigenous interest groups, and a community reference group. It is also recommended that the CMP implement a paid part-time project coordinator during Stage 2, in order to manage the project on a day-to-day basis and oversee the development and implementation of the program.

Stakeholder and Community Engagement

The development of the CMP will include extensive engagement with the local community and user groups, relevant government agencies, and indigenous peoples.

As part of this Scoping Study, a Stakeholder and Community Engagement Strategy has been prepared for the remaining stages of the CMP development process. The strategy has been prepared in accordance with the requirements of the NSW Coastal Management Manual.

The Way Forward

This report has identified a number of studies required during Stage 2 to fill critical data gaps and inform sound management decisions.

A business case and forward plan for development of the five-staged program has also been developed, based on the requirements of the subsequent stages. It is estimated that the CMP will take around 2½ to 4 years to progress through Stages 2 through to 4. The fifth and final stage will involve the ongoing implementation of the program over a 10-year period thereafter.

The overall cost of developing the CMP will likely be in the range of $1.0-1.7 million (Stages 2 to 4 inclusive), but will depend on a number of factors moving forward. The CMP is eligible for financial assistance from the NSW Coastal and Estuary Grants Program, administered by DPIE. Other funding sources should also be pursued.

TABLE EX-1: CMP FORWARD PROGRAM

Stage	Approx. Cost	Approx. Timing
Stage 2: Determine Risks, Vulnerabilities and Opportunities	$580k-$1.1m	15-24 months
Stage 3 – Response Identification and Evaluation	$310-470k	9-15 months
Stage 4 – Finalise, Exhibit and Certify the CMP	$120-230k	9-12 months
Total	**$1.0-1.7m**	**2½ - 4 yrs**

Following approval and certification of the CMP at the completion of Stage 4, the CMP will be implemented in Stage 5 by the partner councils via the Integrated Planning and Reporting framework, and Community Strategic Plans. This framework will guide the implementation of the CMP and ensure all required monitoring and reporting is completed. It will also provide a framework for the review and assessment of CMP outcomes.

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1 INTRODUCTION

1.1 Background

The Hawkesbury-Nepean River system is a major social, environmental and economic asset for the state of New South Wales (NSW). It is the largest river system in the Greater Sydney and Central Coast regions, and contains beautiful iconic beaches, sprawling waterways and tributaries, and areas of social and cultural significance. Along with being a key economic driver for the region, the coastal zone also contains a passionate local community, who are heavily invested in its utility and management.

Future coastal management for the Hawkesbury-Nepean River System will take the form of a Coastal Management Program (CMP). The six (6) councils that border the tidal waterways of the system are partnering to understand what is required for the development of an integrated, whole of system CMP. These councils comprise:

- Central Coast Council;
- Hawkesbury City Council;
- The Hills Shire Council;
- Hornsby Shire Council;
- Ku-ring-gai Council; and
- Northern Beaches Council.

The purpose of CMP would be to establish an integrated program to support the coordinated management and ecologically sustainable development of the Hawkesbury-Nepean River system - which includes the major estuaries of *Brisbane Water, Pittwater, the Hawkesbury River and Broken Bay* - in order to maintain and enhance its social, cultural, economic and environmental values. For the purposes of this report, references to “The Hawkesbury-Nepean River system” refer to the overall river system comprising the Hawkesbury-Nepean River, Brisbane Water, Pittwater, and Broken Bay.

This Hawkesbury-Nepean River system CMP Stage 1 Scoping Study has been prepared through collaboration and to develop a shared understanding of the system and its management. The study also describes the proposed approach for undertaking Stage 2 to Stage 5 of the CMP - consistent with the NSW Coastal Management Framework.

This study has been prepared in accordance with the requirements outlined in the Coastal Management Manual (OEH, 2018a), in consultation with the NSW Department of Planning, Industry and Environment (DPIE), the six partner councils, and key state agencies and associated stakeholders (e.g. wider catchment councils) that play a role in the management of the Hawkesbury-Nepean River system.

1.2 The NSW Coastal Management Framework

The NSW coast provides a multitude of values and uses for the community. This competition for use and enjoyment places the coastline under increasing pressure (OEH, 2018a). Planning for coastal communities must carefully balance the need to provide jobs, housing, community facilities and transport for a changing population while maintaining the unique qualities and recreational activities and, managing risks associated with development along our coastlines (DPIE, 2019).

Sustainable management of the coastal zone involves councils, their communities and public authorities balancing a diverse range of challenges and opportunities. The context is one of rapid environmental, social and economic change along with dynamic coastal processes affecting the open coast, estuaries and coastal lakes (OEH, 2018a).

In order to plan for development, protect environmental assets and manage coastal hazards across the state, the NSW Government has developed the NSW Coastal Management Framework, which includes changes to

legislation and planning policy that aims to provide an integrated framework for coastal management across the state.

Key components of the framework include:

- *Coastal Management Act 2016* (CM Act): Provides for the integrated management of the coastal environment of NSW consistent with the principles of ecologically sustainable development, for the social, cultural and economic wellbeing of the people of the state.
- *Marine Estate Management Act 2014* (MEM Act): Provides for the management of the marine estate of NSW in a manner that promotes a biologically diverse, healthy and productive marine estate and facilitates the economic cultural, social and recreational use of the marine estate.
- Coastal Management State Environmental Planning Policy 2018 (CM SEPP): One of the key environmental planning instruments for land-use planning in the coastal zone. It gives effect to the objectives of the CM Act 2016, and delivers on the statutory management objectives of the act by specifying how development proposals are to be assessed if they fall within the coastal zone.
- The advent of CMPs: A five stage coastal management process intended to set the long-term strategy for the coordinated management of the coastal zone for a given region;
- The NSW Coastal Management Manual (The Manual): A manual that sets forth mandatory requirements (Part A) and provides guidance to coastal councils (Part B) for the preparation, development, adoption, implementation, amendment, and review of CMPs.
- The NSW Coastal Council – which is responsible for advising the Minister on coastal issues, as well as reviewing and approving local council CMPs (when requested by the Minister to do so).

A schematic of the NSW Coastal Management Framework is provided in Figure 1-1.

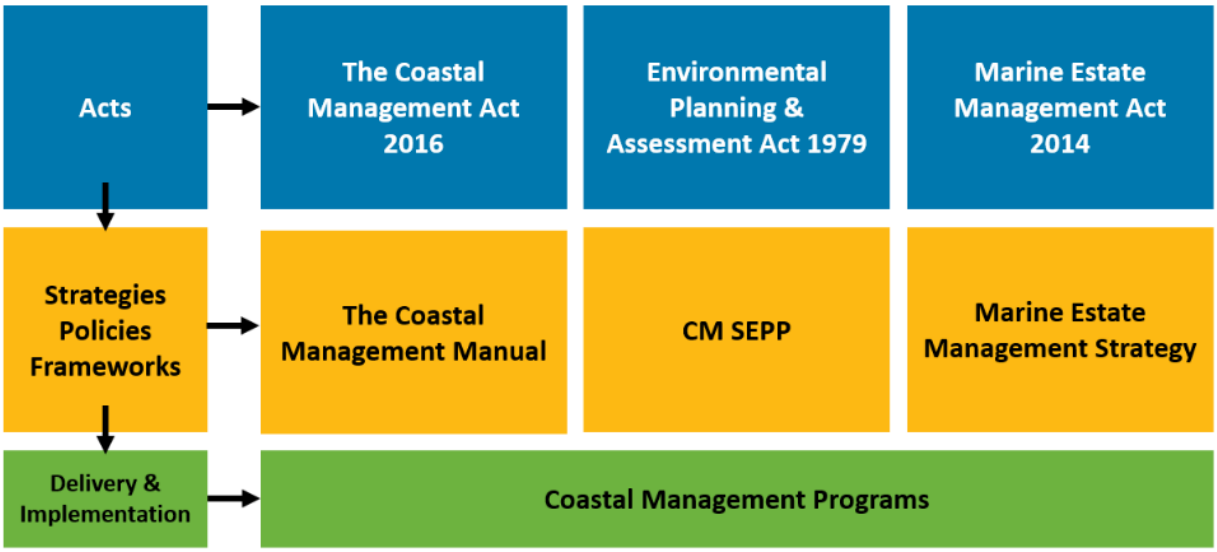


FIGURE 1-1 THE NSW COASTAL MANAGEMENT FRAMEWORK

1.3 The Hawkesbury-Nepean River System Coastal Management Program

The purpose of a CMP is to set the long-term strategy for the coordinated management of the coastal zone of a given area, with a focus on achieving coastal management objectives at a local and estuary-wide level whilst, also achieving the objects of the CM Act. It provides an opportunity for councils, public authorities and local communities to clearly identify and balance competing interests and priorities in the coastal zone.

More broadly, a CMP may be prepared by one or more local councils for a given area. The area that a CMP covers may comprise all or part of the coastal zone of one local government area. Alternatively, where important natural features such as coastal sediment compartments or estuaries cover multiple LGA's, neighbouring Councils may choose to/are encouraged to collaborate and prepare a CMP covering the entire system irrespective of the jurisdictional boundaries.

A CMP is prepared and implemented through a five staged risk management process described in the NSW Coastal Management Manual and depicted in Figure 1-2. This process is intended to help councils and their communities to identify and manage risks to the environmental, social and economic values of the coast. The Manual sets forth mandatory requirements for CMPs, but also provides guidance regarding their preparation, development, adoption, implementation, and review.

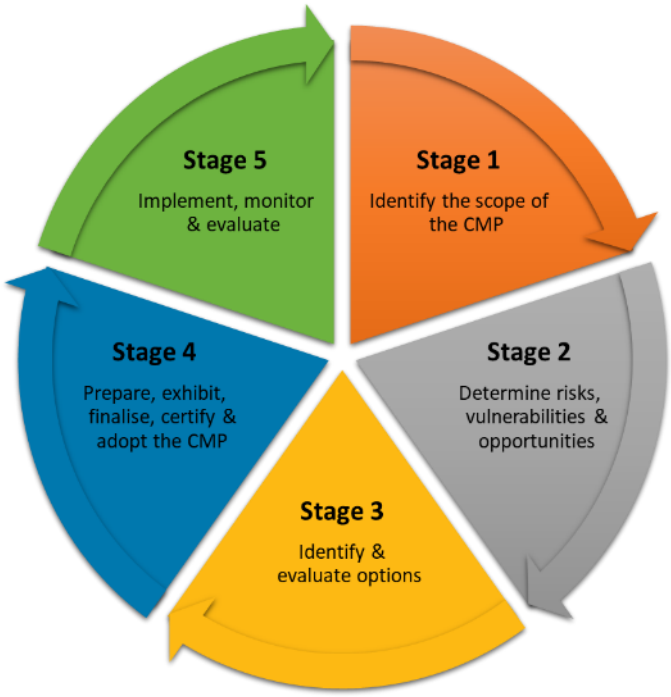


FIGURE 1-2 THE CMP PROCESS

The Manual provides information to help councils to develop, evaluate and select management actions that provide feasible and effective measures to manage the coastal environment. These actions are then incorporated into councils' land-use planning instruments, Community Strategic Plans and Integrated Planning and Reporting (IP&R) Framework, established under the Local Government Act 1993.

In undertaking this Scoping Study, the six partner councils fulfil the first stage of the CMP process. The primary purpose of a Stage 1 Scoping Study is to:

- Review the history of managing the coastal zone;
- Develop a shared understanding of the current situation; and
- Identify the focus of the future CMP.

Stage 1 builds on and integrates with previous work, including existing plans and strategies, technical studies and stakeholder input. It guides councils in formulating appropriate strategies and actions in later stages of the process (Stages 2 to 5).

1.4 The Study Area

The Hawkesbury-Nepean is one of the most important river systems in NSW, and is the largest estuary system in the Greater Sydney and Central Coast regions. The system occupies a unique location and bounds Australia's most populous city to the north and the west, and is situated to the immediate south of a vibrant and growing Central Coast.

Under the CM Act, councils are required to take a systems approach to coastal management, that looks at coastal zone issues in the broader, catchment scale context. For large estuary systems like Brisbane Water, Pittwater, and the Hawkesbury River, a CMP must consider the relationship and interdependence between coastal zone, waterway and catchment systems in order to effectively address system-wide issues and risks, and promote coordination and collaboration across agencies. Therefore, the study area for the CMP comprises the tidal waterways of the Hawkesbury-Nepean River system, including the Brisbane Water Estuary, the

Pittwater Estuary, the Hawkesbury River Estuary and Broken Bay, as well as their contributing catchments. Catchment land uses are described in more detail in Section 3.2.2.

The Hawkesbury-Nepean is the longest coastal catchment in NSW (DPI, 2019). At over 470 km long, the river extends from south of Goulburn all the way to Broken Bay. The river drains over 21,400 km^2 of wider catchment land (DPI, 2019), of which an estimated 70% is forested, 25% is agricultural and around 5% is urbanised (HNCMA, 2005; WRL, 2003). The river-system receives flows from the Grose River to the west and the Nepean to the south, which includes a major hydrological control of the Warragamba Dam – see Figure 1-3).

FIGURE 1-3 THE WARRAGAMBA DAM (SOURCE: INSW)

The tidal waterways of the *Hawkesbury River* commence at the confluence of the Grose River at Yarramundi, and extend around 145 km downstream to the open coast at Broken Bay. The following notable coastal features (and their tributaries) are included in the study area (as depicted in Figure 1-9):

- Broken Bay
- Pittwater Estuary
- The Brisbane Water Estuary
- Patonga Creek
- Cowan Creek
- Mullet Creek
- Mooney Mooney Creek
- Berowra Creek
- Marramarra Creek
- Mangrove Creek
- Macdonald River
- Webbs Creek
- The Colo River
- Cattai Creek
- South Creek
- Rickabys Creek
- The Grose River

From its upstream tidal limit, the Hawkesbury River follows a generally northerly direction, with a relatively sandy composition, and passes through the towns of Richmond and Windsor (which are the largest settlements on the river). Here the river exhibits large meanders and relatively wide floodplains. There are also lagoons and floodplain wetlands like Pitt Town Lagoon and Long Neck Lagoon. At Windsor, the river links with South Creek, which already receives a significant amount of the urban runoff from Sydney's western suburbs and it is currently planned to see significant additional urban development. From Windsor to Sackville the river is wide and deep, and the foreshore is relatively cleared and cultivated (HCC, 2019).

From Sackville to Spencer (Figure 1-4) the river is characterised by steep sandstone cliffs, undeveloped foreshore reserve and a series of low-density floodplain settlements (HCC, 2019). On this stretch the river passes through Lower Portland, where it receives the Colo River. From here the river meanders in an overall north-easterly direction, until it reaches a sharp change of course at the riverside community of Wisemans Ferry (where it is joined by the Macdonald River). This portion of the river is popular with recreational boating, particularly water skiing and wakeboarding. Here its course turns south-eastwards, and the surrounding landscape is

FIGURE 1-4 WISEMANS FERRY

largely comprised of the undeveloped foreshore reserves of the Dharug and Marramarra national parks. The Lower Hawkesbury river is unique in that the foreshore contains significant stretches of forested areas with relatively little foreshore development.

FIGURE 1-5 HAWKESBURY RIVER AT BROOKLYN (SOURCE: DPIE, 2019C)

At the small foreshore settlement of Spencer, the river receives Mangrove Creek from the north, and then around 10 km farther downstream, it also links with Marramarra and Berowra Creeks. At the Mooney Mooney and Brooklyn region (Figure 1-5), the river contains a number of small riverside settlements such as Bar Point, Milsons Passage, Dangar Island and Little Wobby, and the river is traversed by major transport connections that link Sydney to the Central Coast - including the M1 Pacific Motorway and the Sydney-Central coast rail bridge.

The *Pittwater Estuary* is located on the southern side of Broken Bay, at the Tasman Sea entrance (see Figure 1-6). It is a tide dominated drowned valley estuary (Roy, 2001). The estuary extends from Newport and Church Point in the south to its mouth at Broken Bay, and has over 52 km of foreshore and a water surface area of around 17 km^2 (CLT, 2009). Pittwater contains a range of complex physical processes which are governed by the large entrance and the estuary's capacity for exchange with ocean water (L&T, 2002). The tide range across the estuary is largely similar to that of the open coast.

FIGURE 1-6 PITTWATER ESTUARY (SOURCE: DPIE, 2019C)

The foreshores of Pittwater are lined by number of bays, beaches and headlands. Major tributary creeks of the Pittwater include Careel Creek, Salt Pan Creek, Mona Vale Main Drain, Cahill Creek, McCarrs Creek and Salvation Creek (L&T, 2002). Many other small unnamed creeks also drain to the estuary. The system also includes Scotland Island, which is located towards the southern end of the estuary in between Church Point and Clareville and contains a small community of permanent residents. The island is approximately 900 metres in diameter, and is only accessible by boat.

The estuary is an important resource locally and regionally, and is highly valued for its unique environmental setting, delicate estuarine habitats, and its contribution to the local economy and community (NBC, 2017). It is also a major recreational and cultural asset for the region that experiences a high intensity of recreational use, particularly during the peak summer period.

Pittwater has a catchment of nearly 6000 ha which extends from Mona Vale and Warriewood in the south to along the eastern ridge of the Peninsula leading to Palm Beach and then along the western ridge leading to West Head (L&T, 2002). The eastern and southern areas of the catchment are heavily urbanised, include the suburbs of Palm Beach, Clareville, Newport, Bay View and Church Point. To its west, Pittwater is primarily bounded by Ku-ring-gai Chase National Park, which comprises a large area of the Pittwater sub-catchment.

The *Brisbane Water Estuary* (Figure 1-7) is located on the northern side of Broken Bay, and is a wave dominated barrier estuary with an open entrance (Roy, 2001). The estuary extends from Gosford in the north, down to its mouth at Broken Bay, and has over 90 km of foreshore and a water surface area of around 27 km^2 (CLT, 2009). The estuary itself is relatively shallow and contains a number of small embayments and inlets. There are five major waterways that comprise the Brisbane Water Estuary as identified in the Brisbane Water Plan of Management (GCC, 1995). They are:

- Entrance Reach between The Rip and Half Tide Rocks;
- Woy Woy Reach, including Pelican Island, Riley's Island and St Hubert's Island;
- Kincumber Broadwater;
- Brisbane Water (upstream of Pelican Island); and
- Woy Woy Bay and Woy Woy Inlet.

FIGURE 1-7 BRISBANE WATER ESTUARY (SOURCE: DPIE, 2019C)

Brisbane Water has a catchment of nearly 15,000 ha, and drains a number of major creek and waterways. These include, Narara Creek which enters the estuary at Gosford, Coorumbine Creek, Erina Creek, Kincumber Creek, Woy Woy Creek, as well as many other smaller creeks and tributaries. The Brisbane water catchment contains a variety of land uses, and is around 50% undeveloped bushland and national parks (including Brisbane Water National Park). The estuary also contains areas of high-density urban development, including the population centres of Gosford, Erina, Kincumber, Saratoga, Davistown, Empire Bay, Woy Woy, Ettalong and Umina. Brisbane Water also includes the canal estate suburb of St Huberts Island, which was developed in the mid-1970s and is accessed by via bridge at Daley's Point. Two islands within the estuary, Pelican Island and Riley's Island, function as nature reserves and remain largely unaffected by development (CLT, 2008).

The Hawkesbury River, Pittwater and Brisbane Water estuaries all interface with the Tasman Sea at *Broken Bay* (see Figure 1-8), which is classified as a semi–mature tide-dominated drowned valley estuary. Broken Bay is exposed to coastal processes along with beaches and rocky foreshores in the northern portion of Pittwater and Patonga, Pearl, Umina and Ocean Beaches. The bay also contains a series of smaller coastal estuaries such as Patonga Creek, Pearl Beach Lagoon and Ettalong Creek which are each situated adjacent to coastal communities. Cowan Creek, which drains into Broken Bay, is a main arm of the estuary that contains the recreational boating hubs of Cottage Point and Bobbin Head.

FIGURE 1-8 BROKEN BAY (SOURCE: DPIE, 2019C)

The tidal waterways and foreshore span across six (6) LGAs (the partner councils), with an additional eighteen (18) LGAs encompassed across the wider Hawkesbury-Nepean Catchment (either wholly or partly).

The Hawkesbury-Nepean River system comprises a highly connected network of hydrological, and ecological systems, made up of a complex array of aquatic, riparian and terrestrial habitats. The entire Hawkesbury-Nepean catchment is known to contain over 1,100 native vertebrates (including fish, amphibians, reptiles, birds

and mammals) and 1,700 invertebrates (HNCMA, 2005). The Australian estuaries database has classified the Hawkesbury River as having 'high' conservation value, with a 'real' conservation threat (BMT WMB, 2008).

The area's accessibility to the population of Sydney and the Central Coast, the open waterway with sheltered bays and harbours, and its scenic quality make it a very popular destination for a large number of recreational visitors (WBM, 2006b). The river system is also a major economic asset for the Greater Sydney and Central Coast regions. The system directly supports the agriculture and aquaculture industries that provide much of the regions fresh food, as well as supporting numerous other mining, manufacturing and processing industries across the catchment - as well as recreation and tourism (WSU, 2019).

For the purposes of this report, references to "The Hawkesbury-Nepean River system" refer to the overall river system that includes estuary systems of the Hawkesbury River, Brisbane Water, Pittwater, and Broken Bay.

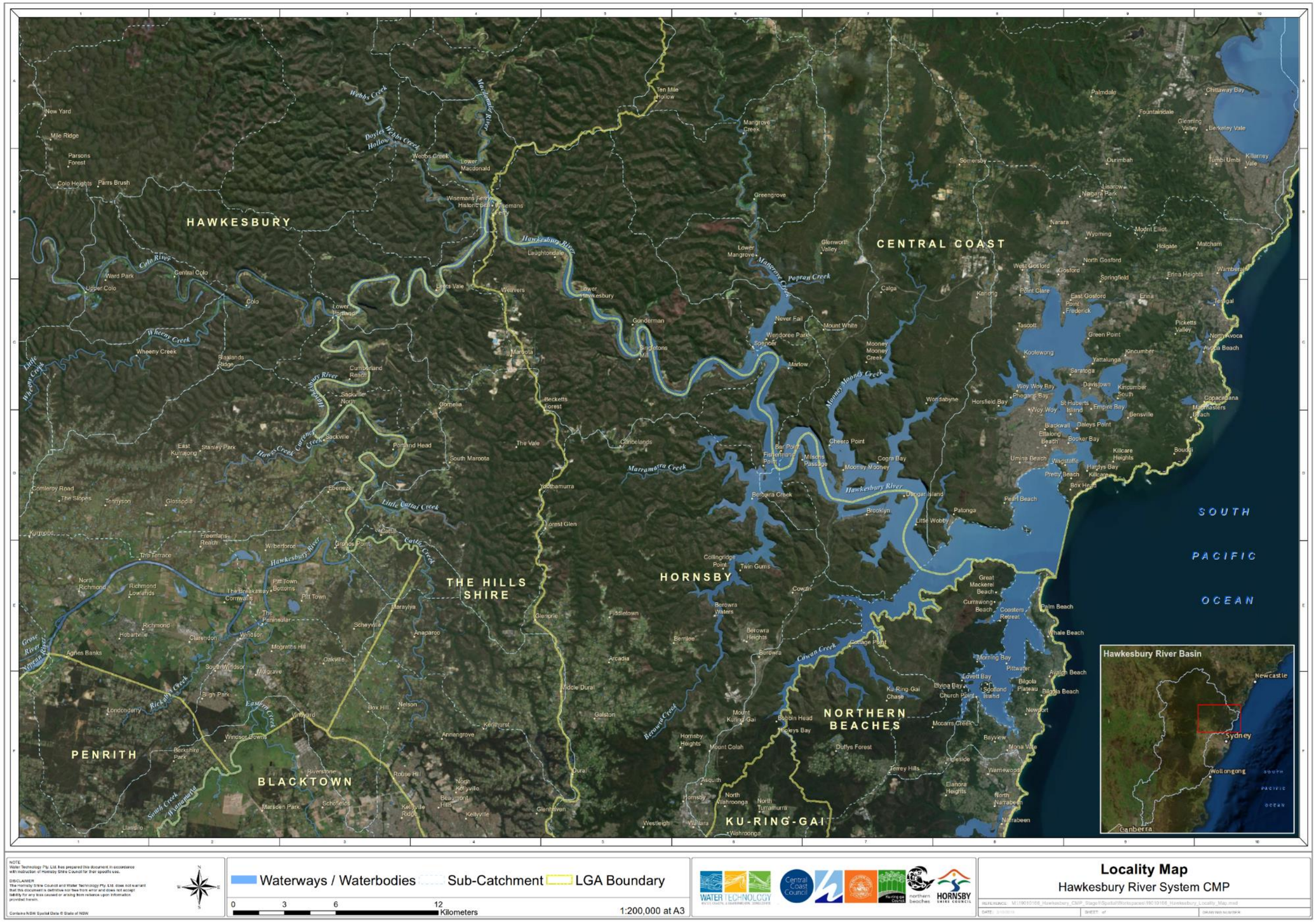


FIGURE 1-9 LOCALITY PLAN

1.5 Governance Structure for Stage 1

The Stage 1 Scoping study is being overseen by a project steering committee (under the leadership of Hornsby Shire Council) which is comprised of the six (6) partner councils and a range of other state government organisations and Local Aboriginal Land Councils (LALCs). A list of the steering committee organisation members is provided in Figure 1-10 below.

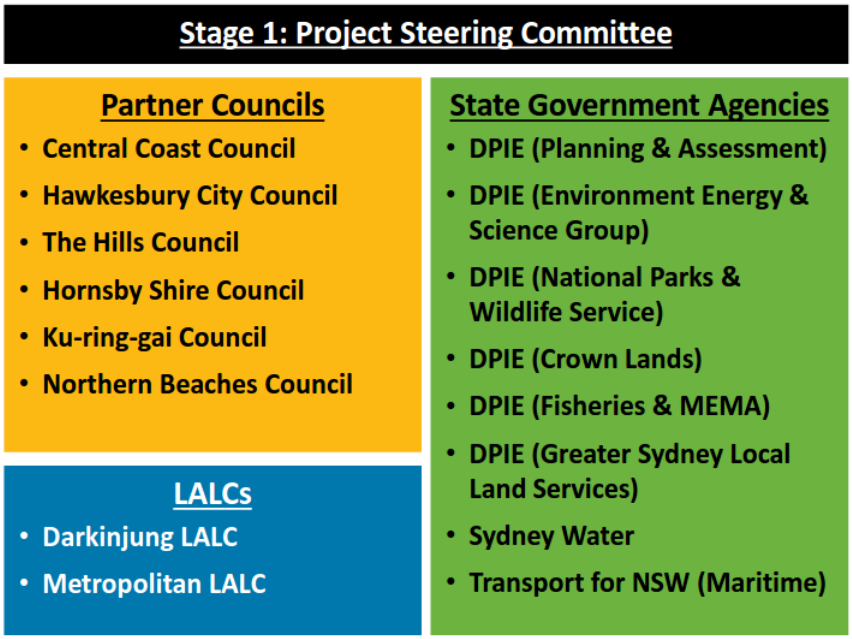


FIGURE 1-10 STAGE 1 CMP STEERING COMMITTEE

In addition to the project steering committee, a range of other organisations and councils from the wider Hawkesbury-Nepean catchment were engaged as part of the Scoping Study (as discussed in Section 4). These additional project stakeholders are provided in Figure 1-11. During development of the Scoping Study, a letter was sent to all councils within the wider Hawkesbury-Nepean drainage catchment (see Section 3.3.1) to inform them about the Scoping Study process.

FIGURE 1-11 ADDITIONAL STAGE 1 PROJECT STAKEHOLDERS

A governance structure for the remaining stages of the CMP has been recommended as part of this study, and is provided in Section 7.

1.6 Structure of this Report

This report meets the requirements of a Stage 1 Scoping Study set out in the Manual. It includes the following components:

- Section 2 outlines the purpose, vision and objectives of the CMP;
- Section 3 provides the strategic context for the CMP, including background information regarding the local environmental processes, governance, applicable policy and management plans, as well as the social and economic use of the waterway;
- Section 4 provides an overview of the stakeholder engagement activities undertaken during Stage 1, and those required during the remaining stages of the CMP;
- Section 5 provides an overview of the study area for the CMP;
- Section 6 summarises the existing coastal zone management plans in place across the estuary;
- Section 7 describes a proposed governance structure for delivery of the remaining stages of the CMP;
- Section 8 details a first-pass risk assessment which identifies the major threats and pressures facing the river system;
- Section 9 provides a gap analysis and recommends further studies required to fill key knowledge gaps during Stage 2 of the CMP;
- Section 10 outlines a forward program for completion of Stages 2 to 4; and
- Section 11 outlines a business case for development of the CMP, and discusses the benefits of undertaking the program.

Effective engagement and communication are important aspects of a successful CMP. A key component of this Scoping Study is the development of a Community and Stakeholder Engagement Plan (provided in Appendix A). This Strategy outlines which organisations should be involved in the review, preparation and implementation of the CMP, how they will be offered engagement opportunities and how their input will be incorporated into the planning process.

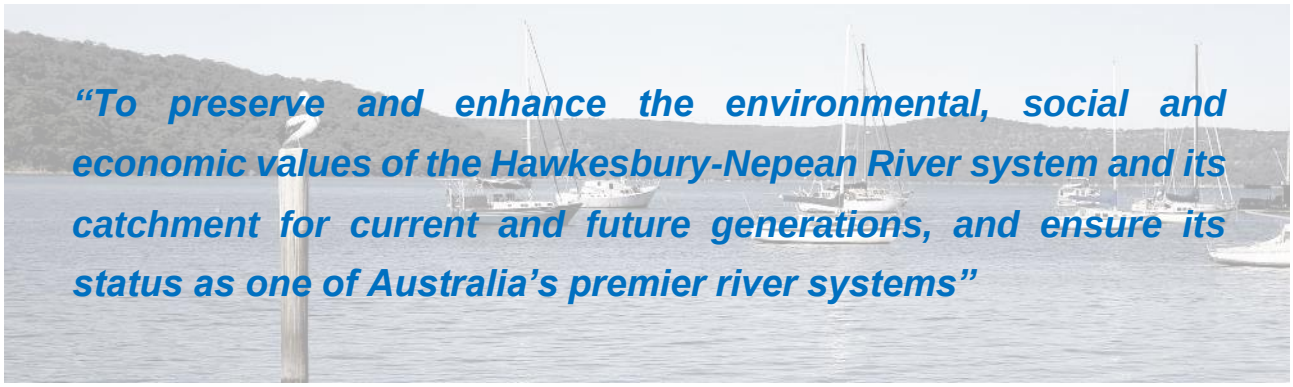
2 PURPOSE, VISION AND OBJECTIVES

2.1 Purpose

The purpose of the CMP is to set the long-term strategy for the coordinated management of the Hawkesbury-Nepean River system, encompassing the estuaries of Broken Bay, Pittwater, The Hawkesbury River and Brisbane Water. The CMP seeks to achieve the objectives of the CM Act through a program to identify coastal management issues, pressures, risks and opportunities - and the actions required to address these issues in a strategic and integrated way.

2.2 Vision

A local vision statement has been developed to help stakeholders identify with the future of the Hawkesbury-Nepean River system, encourage a sense of community ownership of the actions in the CMP, and foster commitment to its preparation and implementation. The vision statement for this CMP has been developed through consultation with the six (6) partner councils for the project. It is intended to reflect the multitude of values the Hawkesbury River system provides, and special place that it holds as one of the most prominent river systems in the nation. The vision statement for the CMP is:



2.3 Objectives

A suite of objectives has been developed for the CMP, in order to ensure that the outcomes of the CMP are consistent with the principles of ecologically sustainable development for the social, cultural and economic well-being of the six partner Council LGAs. They have been developed ensuring consistency and compatibility with the objectives set forth in the following earlier works:

- The *NSW Coastal Management Act (2016);*
- The Coastal Management State Environmental Planning Policy (2018);
- The Sydney Regional Environmental Plan No 20 - Hawkesbury-Nepean River (1997);
- The Central Coast Regional Plan 2036 (DPE, 2017);
- The Greater Sydney Regional Plan (GSC, 2018);
- The Community Strategic Plans of the six partner councils;
- The Greater Sydney Local Land Services Local Strategic Plan 2016-2021 (GSLLS, 2016);
- The Hawkesbury-Nepean Catchment Action Plan 2013-2023 (HNCMA, 2013);
- The NSW Water Quality and River Flow Objectives for the Hawkesbury River (NSW Government, 1999);
- The Marine Quality Objectives for NSW Ocean Waters (DECW, 2006);

- The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC &, ARMCANZ 2000);
- Lower Hawkesbury-Nepean River Nutrient Management Strategy (DECCW, 2010)
- The Marine Estate Management Strategy (MEMA, 2018); and
- The NSW Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions (OEH, 2017)

The objectives of the CMP have been outlined in broad terms, to establish the overall strategic direction of the program. It is anticipated that these objectives will undergo further refinement in consultation with the local community during later stages of the CMP. Currently, the objectives of the Hawkesbury River CMP are:

a) to protect and enhance the integrity and resilience of the environmental values of the Hawkesbury River, Brisbane Water and Pittwater estuaries, including healthy, diverse aquatic ecosystems.

b) to maintain and protect water quality across the system and its impacts on environmental, social and economic values - including ecological condition, recreational amenity and agricultural uses;

c) to maintain and preserve the unique scenic amenity and natural character of the Hawkesbury River, Brisbane Water and Pittwater estuaries;

d) to support the social and cultural values of the system and maintain public access and recreational amenity;

e) to maintain the health, safety and wellbeing of those using the coastal zone (both directly and indirectly) - and to protect the health of human consumers of aquatic foods;

f) to acknowledge Aboriginal peoples' spiritual, social, customary and economic use of the Hawkesbury and to protect local indigenous cultural heritage;

g) to recognise the coastal zone as a vital economic zone and to support sustainable coastal economies such as recreational fishing, aquaculture and tourism;

h) to facilitate appropriate management of the coastal zone through ecologically sustainable development, and the promotion of sustainable land use planning and decision-making that is consistent with regional and local strategic plans;

i) to mitigate current and future risks from population growth, urbanisation and coastal hazards (erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment flooding);

j) to ensure co-ordination between relevant government and public authorities relating to the river system - and to facilitate the proper integration of management activities across all levels of government;

k) to maintain meaningful engagement with the community, and to support public participation in coastal management and planning, and to create greater public awareness, education and understanding of coastal processes and management actions;

l) to encourage and facilitate research and monitoring – and to maintain the scientific and educational values of the river system;

m) to support the objects of the *Marine Estate Management Act 2014*; and

n) to align with the NSW Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions.

3 STRATEGIC CONTEXT FOR THE CMP

3.1 Methods and Limitations

In order to understand and address coastal management issues in a risk framework, there needs to be a clear understanding of the internal and external context in which the CMP is undertaken. Therefore, as part of the Scoping Study, a review has been undertaken of the strategic context for coastal management in the Hawkesbury-Nepean River system – in order to ensure that subsequent stages of the CMP address relevant management issues and that the overall direction of the program is carefully considered. This task has been based on a review of existing information and data, and information supplied by project stakeholders via workshops undertaken during the study.

The overall strategic context for the CMP has been broken down into a series of categories, outlined in Table 3-1 below. Whilst these issues will be studied in further detail during later stages of the CMP, it is important to have a broad understanding of them at the project outset.

TABLE 3-1 ESTABLISHING THE STRATEGIC CONTEXT OF THE CMP

Context	Description of Strategic Context Drivers
Environmental	*What are the environmental features and processes affecting the coastal zone?* ▪ Regional geology and geomorphology ▪ The predominant land use across the catchment and projected future development ▪ Local coastal & estuary processes, including waves, water levels, winds, extreme events, sediment transport, erosion, storm tide inundation and water quality ▪ Local estuarine ecology, habitat extent and health, terrestrial biodiversity and catchment characteristics ▪ Potential climate change impacts
Governance	*What is the governance context of the CMP?* ▪ The political and governance context and the relationships between the partner councils, adjoining councils and other public authorities
Policy	*What is the relevant legislation and policy governing the coastal zone?* ▪ The relevant local, state and federal legislation and policies, land tenure and land managed as national park or crown reserve
Economic	*What is the economic importance of the coastal zone?* ▪ The economic value of the coastline – including economic activity dependant on the coastal zone, such as tourism, commercial and recreational fishing and aquaculture
Management and Planning	*What is the strategic planning framework that the CMP must fit within?* ▪ The relevant coastal and estuary management plans in place across the study area ▪ Relevant state, regional and local plans and strategies
Social and Cultural	*What are the social and heritage values of the coastal zone?* ▪ Indigenous and non-indigenous heritage values of the study area ▪ Population growth and demographic changes ▪ The recreational uses and community values of the coastal zone

3.2 Environmental Context

3.2.1 Geomorphology

The Hawkesbury-Nepean River system is a deeply incised freshwater to estuarine system and is among the largest along the east coast of Australia (Hughes, 1998). The estuarine reach occupies a drowned river gorge carved into Triassic Hawkesbury sandstone (Roy et al., 1980). The channel is flanked locally by steep bedrock valley walls, and laterally restricted back-plain swamps with fringing mangrove stands (Hughes, 1998). The estuary possesses a thick sequence of sediments and occurs in a tectonically stable region (Roy and Thom, 1981; Roy, 1984). The Quaternary period saw a rise in sea level of about 130 metres which drowned the lower Hawkesbury River together with a large part of the eastern Australian coast. The resulting marine, fluvial and swamp deposits were formed by tides, waves, flood and wind - and are observed across the floodplain of the Hawkesbury River and its tributaries (Roy and Thom, 1981).

From a geomorphological perspective, the estuarine reach of the Hawkesbury-Nepean River system is comprised of three predominant waterways that connect to the Tasman Sea via Broken Bay:

- The Hawkesbury River Estuary;
- The Brisbane Water Estuary; and
- The Pittwater Estuary.

Key estuary classification details for each of these waterways are provided in Table 3-2.

TABLE 3-2 ESTUARY CLASSIFICATIONS (ROY ET AL, 2001)

Estuary	Estuary Group	Estuary Type	Evolution stage	Water Area (km^2)	Catchment Area (km^2)	Length of foreshore (km)
Brisbane Water	Wave dominated	Barrier estuary	Youthful	27.2	170	125^
Hawkesbury River	Tide dominated	Drowned valley estuary	Semi-mature	100.0	21,400	810#
Pittwater	Tide dominated	Drowned valley estuary	Youthful	17.3	77	52*

^ sourced from CLT (2008); * sourced from L&T (2003); # sourced from CM SEPP Mapping and approximate only.

The *Brisbane Water Estuary* is classified as a wave dominated barrier estuary with an open entrance (Roy, 2001). Brisbane Water contains a pronounced tidal delta (both ebb and flood) comprising marine sands. The delta extends from the Broken Bay entrance approximately to Pelican Island (CLT, 2008), and takes the form of a series of relatively mobile shoals that are affected by the complex morphological and hydrodynamical processes at the estuary entrance. The central basins of the estuary, such as The Broadwater, are quite different sedimentary environments, and typically comprise organic rich, sub-tidal mud and sandy mud. These fluvial sediments are derived from the catchment and are delivered to the estuary via freshwater inflows from tributary creeks or rivers (CLT, 2008).

The *Pittwater Estuary* is classified as a relatively youthful, tide dominated, drowned valley estuary. Pittwater is classified as being in a 'youthful' stage of development due to the limited extent of fluvial reclamation and its extensive and deep mud basin (L&T, 2003). The deep mud basin presently comprises Pleistocene sediments that are overlain by deposited Holocene marine sediments (Roy, 1980) in the form of a flood tide delta. The tidal delta extends around 2 km into the estuary southward from the mouth to a drop-over approximately located around Observation Point. Pittwater is still slowly accumulating fine sediment within the deep mud

basin, while coarser fluvial sediments are accumulating within fluvial deltas closer to the tributary sources (L&T, 2003).

The present-day *Hawkesbury River Estuary* is divisible into three broad sedimentary zones, as per Nichol et al (1997) and depicted in Figure 3-1:

- Zone A is an outer marine-dominated zone extending around 6 km upstream from the mouth of the estuary within Broken Bay estuary mouth that is characterised by a large, subtidal sandy flood-tidal delta. Ocean wave energy is partially dissipated by this flood-tidal delta, so that tidal level fluctuations are the predominant marine mechanism operating further landward. The sediments within the mouth of Broken Bay are primarily Holocene sediments sourced from the continental shelf and transported landward following the end of the last ice age some 17,000 years ago (L&T, 2003).
- Zone B represents the central basin with deposition of finer grained sediments derived from the river catchment. This is essentially a low-energy environment characterised by sub-tidal and intertidal muds and muddy sands.
- Zone C represents the bulk of the Hawkesbury Estuary System, and is river-dominated comprising distributary channels, levees, and overbank floodplain deposits of mixed lithologies. The upper reaches of the zone occupy deeply incised bedrock valleys.

The estuary is considered semi-mature, and this is exemplified in the upper estuary where geological studies (Nichol et al., 1997) have shown that in the mid-Holocene, estuarine conditions existed well upstream of the present riverine channel zone but have been displaced downstream as the estuary infilled.

Hubble and Harris (1994) surmised that the upstream channel morphology is mostly of a fluvial nature and shaped by infrequent flood events rather than by the tides. The channel width of the estuary decreases exponentially from the entrance, from roughly 3,500 m at Broken Bay to around 150 m at the tidal limit at Yarramundi (Hughes et al, 1998). The depth of the estuary decreases from 15 to 20 m in Broken Bay to roughly 10 m at 100 km inland, and around 2 m at the tidal limit.

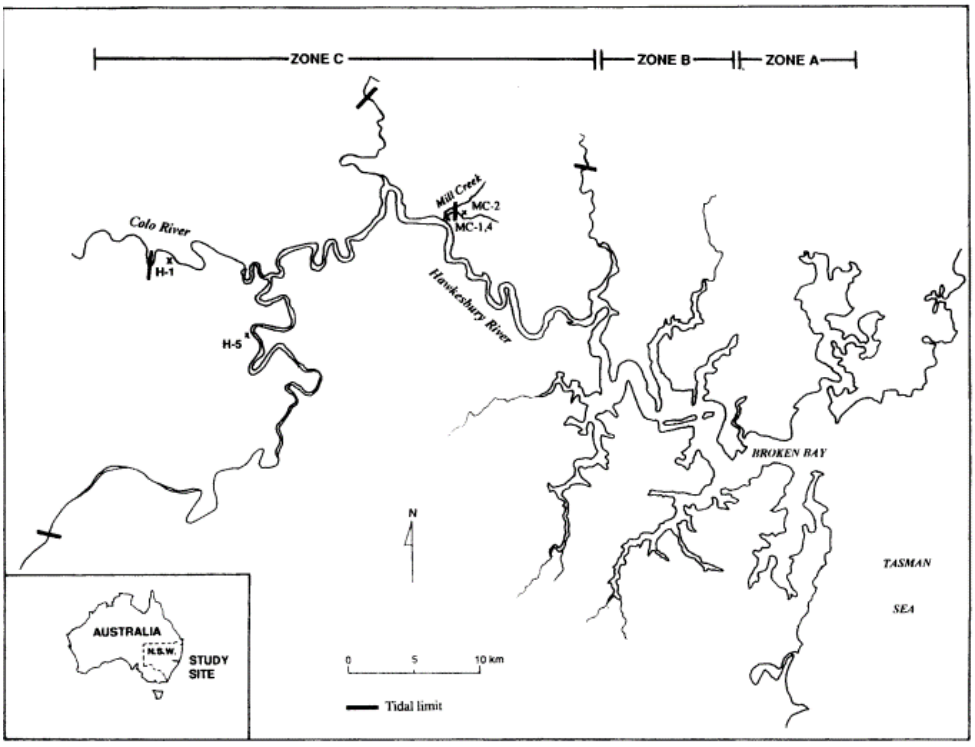


FIGURE 3-1 SEDIMENTARY ZONES OF THE HAWKESBURY (SOURCE: DEVOY ET AL,1994)

The CMP study area lies wholly within the wider *Broken Bay coastal sediment compartment*, which extends from Third Point to Barrenjoey Head – in between the *Sydney Northern Beaches* and *Central Coast* sediment compartments.

3.2.2 Land Use and Development

A breakdown of the land use across the various sub-catchments of the study area is provided in Table 3-3 below, based on Roper et al (2011) and review of local coastal and estuary process studies. The land use across the lower Hawkesbury River catchment is also depicted in Figure 3-2. The land uses across the catchment mainly include urban areas, conservation and natural environment areas, and agricultural use such as grazing. The majority of the wider Hawkesbury-Nepean catchment (>70%) comprises undeveloped bushland and national parks – and almost half of the catchment is protected in over 1 million hectares of national parks and reserves. However, the distribution of land use across the catchment varies geographically.

TABLE 3-3 LAND USE COMPOSITION ACROSS THE STUDY AREA CATCHMENTS (ROPER ET AL, 2011)

Land Use	Brisbane Water	Hawkesbury-Nepean	Pittwater
Catchment Size (excluding water area)	14,380 ha	2,130,000 ha	5,970 ha
Bushland / National Park	48%	72%	71%
Urban	25%	2%	20%
Rural / semi-urban	18%	<1%	9%
Agricultural	6%	26%	<1%
Other	3%	3%	<1%

The upper Hawkesbury-Nepean catchment is dominated by natural bushland, agricultural use and forestry. Grazing is by far the dominant agricultural land use by area in the catchment, although horticultural (turf and vegetable) farming is also common throughout the region.

Within the tidal waterway catchment, the Upper Hawkesbury catchment contains a variety of land uses. The region from Yarramundi to Cattai contains a mix of low intensity urban development and rural agricultural land – with localised pockets of higher intensity urban development at areas such as Windsor and Richmond. Agricultural use comprises horticultural production and grazing. The Colo and Macdonald River Catchments are majority natural bushland in the National Parks estate, with low intensity riverside settlements scattered along the foreshore.

The Lower Hawkesbury catchment also contains a significant coverage of national parks. Agricultural land use across the catchment includes market gardening, orchards, nurseries, poultry production, stud farms and low intensity grazing (DLWC, 1997). Some industrial land use exists across this area, with Somersby, Kariong and Peats Ridge comprising local industrial centres (WRL, 2003). Foreshore development along the Lower Hawkesbury Estuary is very limited, with small localised pockets of development situated amongst the vast expanses of undeveloped foreshore reserve. These include Brooklyn, Dangar Island, Little Wobby, Mooney Mooney Point, Milson Passage, Bar Point and Cheero Point. In some cases, these settlements are only accessible by boat. Along Mangrove Creek, riverside settlements are found at Marlow, Spencer, Wendoree Park, Never Fail Park and Lower Mangrove, and upstream there is development at Laughtondale and Wiseman's Ferry (BMT WBM, 2008).

Across the Brisbane Water catchment, much of the western and southwest of the catchment in occupied by Brisbane Water National Park and Bouddi National Park respectively (CLT, 2008). The catchment is partly urbanised, with major concentrations of development located at Gosford in the north, and the region of Umina Beach, Ettalong Beach and Woy Woy in the southwest (CLT, 2008). Across the Pittwater Estuary catchment,

land use has generally changed since European settlement from bushland areas to urban residential areas on the southern and eastern shores, and these are amongst the most intensively developed foreshores on the Hawkesbury estuary (Kimmerikong, 2005). Conversely, the western shores have more or less remained as undisturbed bushland including the Ku-ring-gai Chase National Park (L&T, 2003).

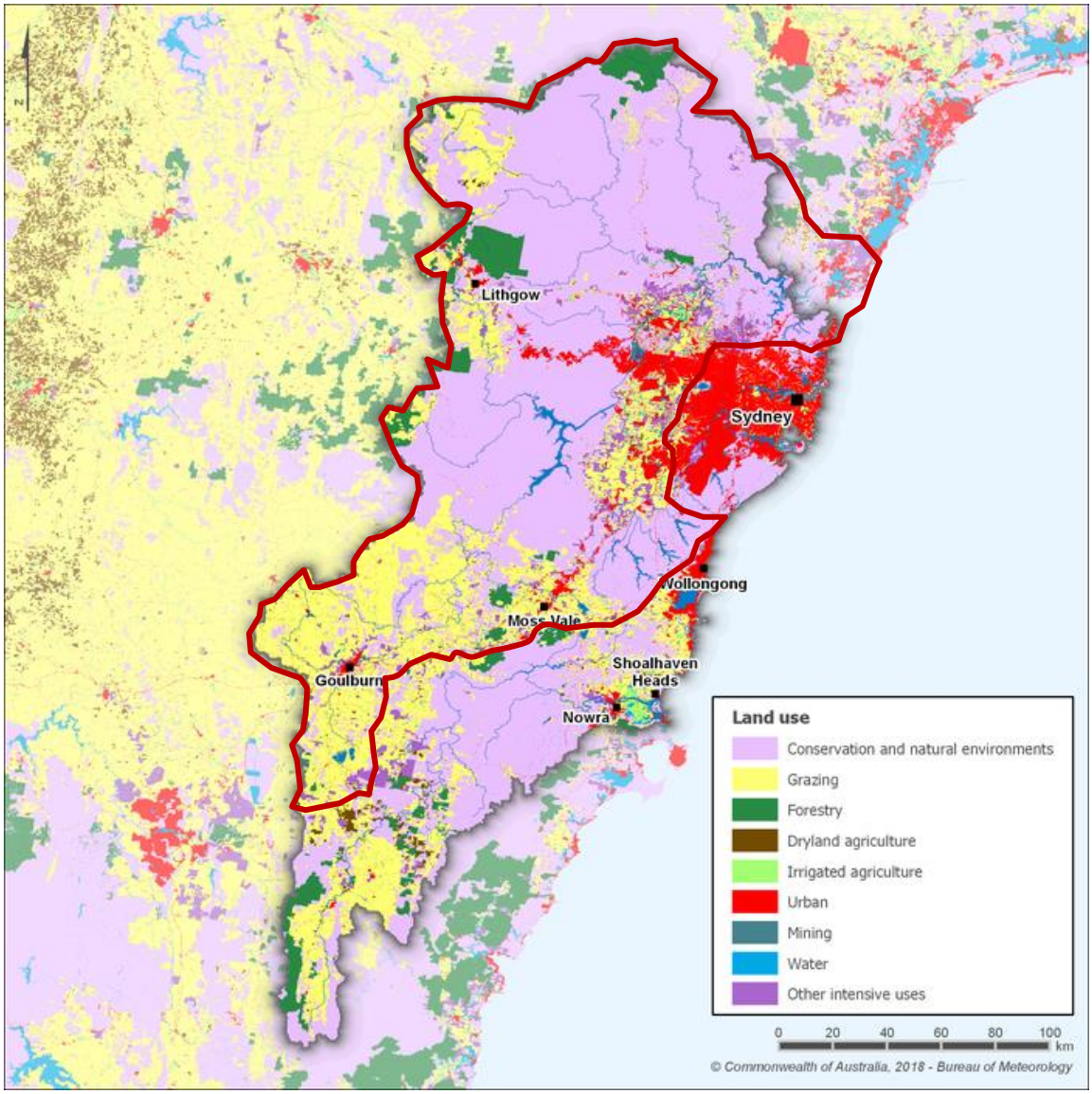


FIGURE 3-2 LAND USE ACROSS LOWER HAWKESBURY RIVER CATCHMENT (SOURCE: ABRES, 2016). HAWKESBURY-NEPEAN CATCHMENT IN RED OUTLINE

Major Infrastructure across the Study Area

A range of critical infrastructure exists across the coastal zone of the estuary, managed by a range of private and public bodies. Some key items are broken down below by LGA in Table 3-4.

TABLE 3-4 MAJOR INFRASTRUCTURE ACROSS THE ESTUARINE REACH OF THE STUDY AREA

Type	Infrastructure
Major Bridges	▪ Sydney to Newcastle Railway Bridge ▪ The Brooklyn Bridge (the M1 motorway) ▪ Peats Ferry Bridge (Pacific Highway) ▪ Greens Rd Bridge, Lower Portland ▪ The Windsor Bridge (the Hawkesbury River Bridge) ▪ Richmond Bridge. Richmond ▪ The Rip Bridge, Brisbane Water ▪ Spike Milligan Bridge, Woy Woy ▪ Woy Woy Railway Bridge ▪ Gosford Rail Bridge
Car Ferries	▪ Sackville Ferry ▪ Lower Portland Ferry ▪ Webbs Creek Ferry ▪ Wisemans Ferry ▪ Berowra Waters Ferry
Service Pipelines	▪ The Wilton to Newcastle trunk pipeline (the 'northern trunk') of the NSW Gas Network passes under the Hawkesbury River in between Mooney Mooney and Marlow
Marinas	▪ There are 26 marinas located in the estuary that provide a total of total of 1,686 wet berths (Roylat, 2013). These include: ▪ 9 marinas in the Brooklyn area ▪ 8 marinas in Pittwater ▪ 5 marinas in the Brisbane Water area ▪ 2 marinas in the Cowan Creek area and ▪ 2 marinas at Berowra Waters
Wharves	▪ Roylat (2013) estimates that there are around 93 public wharves across the estuary (downstream of Wisemans Ferry), including 29 located in Pittwater, and 43 in Brisbane Water; ▪ Commuter berths are estimated to total 282 across the system (Roylat, 2013), including 40 in the Berowra Creek sub-catchment, 140 in the Brooklyn sub-catchment and 95 in Pittwater. ▪ The total replacement value for all moored and berthed vessels on the Hawkesbury River estuary is estimated at $1.5 billion, of which $1.06 billion worth, or more than two thirds by value, are located in Pittwater (Roylat, 2013).
Boat Ramps	▪ Of the approximately 40 boat ramp facilities located in the estuary, including: ▪ 23 in Brisbane Water ▪ 16 in The Hawkesbury River; and ▪ 3 in Pittwater

There are over 40 wastewater treatment plants (WWTPs) and Water Recycling Plants (WRPs) that discharge to the Hawkesbury-Nepean River System (BMT WBM, 2013a) that are managed by a range of local councils across the study area, as well as Sydney Water. Those managed by Sydney Water as listed in Table 3-5 for reference.

TABLE 3-5 WWTP'S MANAGED BY SYDNEY WATER ACROSS THE HAWKESBURY-NEPEAN CATCHMENT

Plant		Discharge Location
Wastewater Treatment Plants	Brooklyn	Hawkesbury River, Brooklyn
	Hornsby Heights	Calna Creek to Berowra Creek
	North Richmond	Redbank Creek to the Hawkesbury River
	Riverstone	Eastern Creek to South Creek
	Wallacia	Warragamba River

Plant		Discharge Location
	West Hornsby	Waitara Creek to Berowra Creek
	Winmalee	Unnamed creek to the Nepean River
Water Recycling Plants	Castle Hill	Cattai Creek
	Penrith	Some excess discharged to Boundary Creek
	Picton	Some excess discharged to Stonequarry Creek
	Quakers Hill	Some excess discharged to Breakfast Creek
	Richmond	Excess overflows to Rickabys Creek
	Rouse Hill	Excess discharged to Second Ponds Creek via wetlands to Cattai Creek
	St Marys	Some excess discharged to South Creek
	West Camden	Remainder discharged via Matahill Creek to the Nepean River

3.2.3 Catchment and Estuary Processes

Catchment Hydrology and Inundation

A snapshot of the hydrology for the three estuary catchments is provided in Table 3-6 below, based on Roper et al (2011). As discussed, the total catchment area of the Hawkesbury River Estuary is very large, just over 20,000 km^2. However, freshwater discharge into the estuary is relatively modest. Generally speaking, the fluvial flow into the Hawkesbury River estuary is highly skewed towards small discharges, and the general pattern of freshwater discharge is one of extended low-flow conditions punctuated by short-duration, large-magnitude floods. Hughes et al (1998) found that floods often have discharge rates up to 3 orders of magnitude larger than the mean. Flow in the river is also influenced by licenced extractors for agricultural and industrial use (BMT WBM, 2013a). Natural river flows are relatively low, owing to the network of dams and weirs across the system, primarily and the extraction of water for metropolitan water supply (BMT WBM, 2013a).

WaterNSW releases five megalitres (ML) of water each day from Warragamba Dam to dilute effluent discharge from the Wallacia sewage treatment plant into the Warragamba River. Another 17 ML of water is released each day in winter, increasing to 25 ML in summer, for Sydney Water to extract at its North Richmond Water Filtration Plant. These releases are specified in the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011. In the 2010 Metropolitan Water Plan, investigations into a new environmental flow release regime from Warragamba Dam were announced. The Department of Finance and Services is currently coordinating these investigations with substantial contributions from WaterNSW (WaterNSW, 2020).

In the lower estuary, catchment flooding may infrequently dominate the hydrodynamics of the main channel. Large scale flooding in the Hawkesbury-Nepean catchment results in a significant flow of freshwater and a net downstream flow through the Lower Hawkesbury. During a large flood, freshwater inputs of more than 1,000,000 ML/day may be discharged through the river (BMT WBM, 2008).

A number of coastal and catchment flood studies have been undertaken across the Hawkesbury River estuary over the years, and generally speaking, interpretation of numerous studies over the years suggest that the catchment flooding governs the design water levels upstream of the Brooklyn Bridge (approximately – noting that this will be different for each event).Given the response time of the catchment and the fact that the flood peaks will reach the lower regions of the Hawkesbury-Nepean after several days have passed, it is considered that elevated ocean levels are unlikely to coincide with the catchment flood peak in the Hawkesbury River Estuary (WMA, 2019).

TABLE 3-6 ESTUARY CATCHMENT HYDROLOGY (ROPER ET AL, 2011)

Estuary Catchment	Annual Catchment Rainfall (mm/yr)	Approx. Average Annual Flow (ML/yr)	Runoff Coefficient
Brisbane Water	1,100	45,000	0.25
Hawkesbury River	750	2,400,000	0.15
Pittwater	1,100	6,000	0.11

The catchment of the Brisbane Water estuary is comparatively more urbanised than the Hawkesbury River estuary or Pittwater, with a significantly higher runoff coefficient. Within Brisbane Water, catchment flooding tends to dominate in the various upstream regions of the contributing tributaries, whilst elevated water levels govern flooding across the Broadwater and estuary entrance (CLT, 2008). Catchment flooding also has significant impacts across the estuary's various bays and inlets, notably Fagans Bay and Woy Woy Inlet.

Within Pittwater, catchment flows to the estuary have only minor, local impacts on hydraulic processes and flooding is generally governed by coastal storm tides.

Water Quality

The water quality of the Hawkesbury River is influenced by flows from local catchments, flows from wastewater treatment plants, spills and environmental releases from storages (BMT WBM, 2013a).

In the upper estuary, in the reach from Yarramundi to Windsor, monthly water quality monitoring undertaken by WaterNSW (formerly the Sydney Catchment Authority) since 2000 indicates that the water quality is generally good with low turbidity and metal concentrations (BMT WBM, 2013a). Water quality is generally compliant with ANZECC (2000) guidelines for pH, turbidity, total and filterable phosphorus concentrations, however some issues regarding dissolved oxygen and nitrogen have been identified (BMT WBM, 2013a).

The poorest water quality in the Hawkesbury River occurs in the reach between the inflows of Windsor and Sackville due to high nutrient concentrations – and these have historically resulted in infestations of aquatic weeds and persistent algal blooms. The poor water quality is largely due to effluent from wastewater treatment plants (WWTPs) that discharge into South Creek and Cattai Creek, and the intensive agricultural areas that contribute high nutrient loads to the river, particularly during wet weather (Kimmerikong 2005). Trend analysis undertaken by Sydney Water has shown that nutrient concentrations have gradually decreased over time (1994-2011) due to enhanced catchment management processes and installation of catchment remediation devices that treat catchment run-off improving the water quality (BMT WBM, 2013a; HSC, 2015;Sydney Water, 2019). Despite the reduced nutrient concentrations, algal blooms are still prevalent between Windsor and Sackville and as far downstream as along Berowra Creek (Kimmerikong 2005; HSC, 2019a). Diffuse runoff from agriculture and stormwater sources are also a large contributor to the local water quality issues. Bacterial contamination also contributes to poor water quality, in particular upstream of Berowra Creek that is heavily influenced by urban run-off and during wet-weather discharges from WWTPs.

Overall, the water quality at the majority of long-term freshwater sampling sites around Hornsby LGA has remained relatively stable despite an ever-growing population and increasing development pressure (HSC, 2019a). Waterways in urban areas are displaying symptoms of 'urban stream syndrome' consistent with other Australian and international urban areas (Vietz et al 2015). Estuarine sites between Wisemans Ferry and Brooklyn are exhibiting impacts from pressures that extend well beyond the Hornsby LGA, particularly with regards to increasing nutrient concentrations coming from the upstream areas of Wisemans Ferry. Bacteria levels at estuarine sites are low and mostly compliant with the reference sites, however Marramarra Creek and Crosslands Reserve sites are close to the tidal limits and susceptible to freshwater catchment inputs. Industrial sites still remain a source of poor water quality, hence audits and education will be rolled out to improve the level of water quality.

In the lower estuary, most indicators show generally good water quality due to increased flushing and mixing of oceanic waters – however there are impacts from the issues experienced further upstream. Studies by DECCW (2009) have showed that turbidity within the estuary generally decreases with distance downstream from the tidal limit. In the lower estuary, median turbidity values are generally below 10 NTU (WRL, 2002). However, Hughes (1998) also showed that a localised turbidity maximum occurs between 30 and 40 km from the estuary mouth. This local maximum coincides with an intertidal and subtidal mud deposition zone, located between 20 and 50 km from the estuary mouth, which has experienced significant shoaling (i.e. net mud accumulation) since the early twentieth century.

Within the Brisbane Water Estuary, there is a relatively high degree of spatial variability in water quality. Heavy rainfall events and the associated urban runoff occurs relatively sporadically and can have a significant, short-term impact on estuarine water quality (CLT, 2009). This process is the most pronounced near the mouth of the various tributaries, particularly in Correa Bay, Kincumber Creek and in The Broadwater near the mouths of Narara and Erina Creeks. Generally speaking, the lowest water quality is exhibited within Kincumber Creek, due to the heavily urbanised catchment, however the highest pollutant loads arrive from Narara Creek owing to the higher magnitude of flows.

Within Pittwater, the water quality is generally considered acceptable, however temporarily degraded water quality during heavy rainfall, particularly from a human health perspective, is observed for some beaches and embayments owing to urban stormwater runoff. Water clarity is generally considered high in the main estuary body, although L&T (2003) showed that the various tributaries and Scotland Island experience elevated turbidity during rainfall events due to runoff from urban development.

A number of swimming and recreational sites are actively monitored by partner Council as part of the Beachwatch program or as part of in-house Council's water quality monitoring program.

Salinity

During periods of modal runoff, the Hawkesbury estuary is partially mixed, with the limit of marine saline intrusion located around 70 km upstream of the mouth at Sackville (Nichol, 1997). Under these conditions, longitudinal salinity gradients initiate density currents that promote the seaward flow of fresh surface waters that overlie the landward flow of saline bottom waters. Upstream of this 70km limit, the estuary is permanently characterised by a freshwater tidal reach (Kimmerikong, 2005).

Within Brisbane Water, the estuary generally exhibits oceanic levels of salinity across the lower reaches and the main broadwater, whilst brackish conditions occur along various upstream regions of the contributing tributaries with the degree of brackishness depending on rainfall and catchment inflows. Salinity across Pittwater generally matches that of the open ocean, and fresher catchment flows are rapidly mixed and absorbed by the estuary upon discharge.

Tides

Tides on the central NSW coastline are semi diurnal with diurnal inequalities. That is, there are two high tides and two low tides per day that are generally at different levels (i.e. the two high tide levels are different in any one day). The mean spring tide range is about 1.3 m and the maximum tide range is around 2.0 m at the coastline, with HAT around +1.1 mAHD.

The tide range within the various estuaries generally reduce with distance upstream. The tide affected part of the Hawkesbury is around 140 km long, with the tidal limit located at the Grose River confluence at Yarramundi. Hughes (1998) showed the tide range within the estuary increases slightly to a maximum of 2.1 m at Gunderman (around 50 km upstream from Broken Bay) and then decreases to zero at the tidal limit (Hughes et al, 1998). The tidal phase lag is around 2 hours from Broken Bay to Wisemans Ferry, and around 5 hours to Windsor. Information regarding the tidal limits of the various estuaries is provided in MHL (2005), and the reader is directed to that document for further detail regarding the tidal limits of the estuaries various tributaries.

The tidal range across the Pittwater estuary is relatively constant and is consistent with the Broken Bay tides. This suggests that Broken Bay tides propagate into and out of the estuary with minimal transformation or modification. There is approximately a 5-minute phase lag in the tides between the estuary entrance and Newport.

The tidal range across the Brisbane Water estuary is reduced relative to Broken Bay tides, and there is significant spatial variability in the tidal range across the estuary. Tides at Ettalong are attenuated by of the order of 15% from the ocean range due to the presence of the tidal delta at the entrance (CLT, 2008). The Rip is a major control on tidal range in the upper estuary and the volume of water exchanged between Brisbane Water and Broken Bay. This feature is located between Ettalong and Woy Woy. There is a significant reduction in the tidal range upstream of The Rip and a phase change of approximately 1-hour in the tidal signal. The maximum tide range within the estuary broadwater is around half that of the open ocean (MHL, 2012).

Wave Climate

The regional wave climate is a dominant factor in the coastal processes of the lower estuary. The deep-water wave climate of the central NSW coast comprises a highly variable wind wave (local seas) climate, combined with a persistent long period, moderate to high energy east to south-easterly Tasman Sea swell. Modal offshore significant wave heights are in the range of 0.5-2.0 metres with spectral peak periods predominantly in the range 7-12 seconds (Kulmar et al, 2013). The wave climate is periodically affected by large wave events originating from offshore storms systems – which include east coast lows and southerly secondary lows (WRL, 2011).

Waves within Pittwater and Brisbane Water estuaries are generally dominated by attenuated offshore swell near their entrances, but local wind wave activities farther upstream. These local wind waves have significantly shorter wave periods than swell, generally around 1 to 3 seconds, and within the estuaries they are generally limited by the available fetch across the water body.

Coastal and Estuarine Erosion

Bank erosion is a significant issue throughout much of the Upper Hawkesbury River Estuary (BMT WBM (2013a). Causes of bank erosion include wind waves, boat wash, uncontrolled stock access, sediment starvation and slumping, and lack of riparian vegetation (Kimmerikong, 2005). Bank erosion is also common around foreshore structures throughout the upper estuary, as a result of “end effects” from diversion of flows (BMT WBM, 2013a). Generally speaking, the vulnerability of riverbanks to erosion across the Lower Hawkesbury River estuary is somewhat lower (WRL, 2014), owing to the high prevalence of natural rock armouring across the foreshore and the fact that a significant extent of the foreshore is in a natural state occurring within the NSW National Parks estate. As such, foreshore development and grazing hard hoof stock is generally absent, and native riparian vegetation is generally intact (WRL, 2014).

Foreshore erosion across Brisbane Water is relatively common, and CLT (2009) found that there is a high potential for long term shoreline recession within Brisbane Water Estuary because beach recovery is limited by the lack of swell wave energy. In some locations this process is exacerbated by a combination of climate change effects such as changes in storm intensity and frequency, projected sea-level rise (SLR) and uncontrolled shoreline development.

Historically, the Broken Bay Beaches have been the most exposed to storm erosion within the study area. Beaches, including Pearl Beach and Umina are directly exposed to the southerly and easterly Tasman sea swell, and are periodically affected by significant storm erosion events. Historically, erosion issues have been observed between Ocean Beach, Ettalong and Booker Bay, and such erosion can threaten the adjacent coastal infrastructure and assets.

The northern regions of Pittwater (Mackerel Beach in the west and north of observation point on the eastern shores) are also exposed to the strong southerly to easterly swells that are generated by east coast lows and other storm events.

Historical Storm Events

In terms of coastal storm events, the key storms to have affected the lower estuary occurred in May-June 1974, May-June 1978, September 1985, August 1986, September 1995, May 1997, and June-July 2007 (WorleyParsons, 2014). In more recent times, the study area has also been affected by the east coast low (ECL) events of April 2015 and June 2016. The highest water levels ever recorded across the lower estuary (including Brisbane Water and Pittwater) occurred during the severe east coast low event of May 1974, which generated close to 100 years ARI storm tide conditions (CLT, 2008 and L&T, 2003).

The April 2015 ECL event generated significant erosion across the Broken Bay beaches – particularly at Pearl Beach and Ocean Beach (see Figure 3-3) including Bradley's Beach on Dangar Island. Coastal erosion and inundation associated with the June 2016 ECL event was reported along the whole NSW coastline. The event produced between a 5- and 10-year ARI significant wave height at the Sydney Waverider Buoy, with a maximum recorded Hs of 6.5 m (Burston et al, 2017) and an associated peak wave period of around 14 seconds. Storm related erosion was reported from this event at Pearl Beach and Umina/Ocean Beach, whilst impacts were also recorded within Pittwater at Great Mackerel Beach and to a lesser extent to the north of Observation Point.

FIGURE 3-3 EROSION AT UMINA BEACH IN 2015 (LEFT) AND 1986 FLOOD AT WINDSOR (RIGHT)

In terms of catchment flooding, the largest flood on record in the Hawkesbury-Nepean Valley occurred in June 1867 when the river level reached 19.7 metres Australian Height Datum (AHD) at Windsor (Ribbons et al, 2015). Other significant floods across the upper estuary (as measured at Windsor) include November 1961, June 1964, June 1975, March 1978, August 1986 (see Figure 3-3), May 1988, August 1990, February 1992 and February 2020.

3.2.4 Study Area Ecology & Biodiversity

Despite 200 years of European settlement, the Hawkesbury-Nepean catchment remains an area of considerable biodiversity (Recher, 1993). The Hawkesbury-Nepean River system represents the interface between a range of different environments, comprising both marine and freshwater, as well as terrestrial and aquatic. Within these broad environments exists a wide array of different habitats ranging from terrestrial (bushland), to intertidal (wetlands/saltmarsh, mangroves, mudflats), and aquatic habitats such as seagrass beds, submerged rock platforms and sandy or muddy estuarine beds (CLT, 2008). The system provides a diversity of habitats for a range of terrestrial and aquatic species, and the river system supports some significant natural assets such as Nature Reserves and State protected wetlands (CLT, 2008; Astles et al 2010).

Flora

There is a variety of aquatic and riparian vegetation that is present across the study area. Statistics for key estuary habitat parameters, as adopted from Roper et al (2011), are provided in Table 3-7. This table quantifies the relative distribution of seagrass, mangrove and saltmarsh throughout the three predominant waterways of the study area.

TABLE 3-7 ESTUARY HABITAT PARAMETERS (ROPER ET AL, 2011)

Estuary Catchment	Area of Seagrass (ha)	Area of Mangrove (ha)	Area of Saltmarsh (ha)
Brisbane Water	558	208	112
Hawkesbury River	92	983	288
Pittwater	185	18	3
Total	***835***	***1209***	***403***

The upper reaches of the estuary are generally comprised of freshwater wetlands. Riparian vegetation is an important component of the Upper Hawkesbury River estuarine ecology due to its provision of habitat and role in bank stabilisation. However, the riparian vegetation is in relatively poor condition throughout the upper estuary (BMT WBM, 2013b) due to a number of threats that include clearing, grazing, boat wake related erosion, and the invasion of exotic weeds. Nonetheless, some tributaries in the upper estuary are in relatively good condition, including Webbs Creek and the Colo River (BMT WBM, 2013b).

Large freshwater back-swamps and lagoons occur across the floodplain. This includes Pitt Town Lagoon and Long Neck Lagoon (see Figure 3-4), which are both listed on the register of the National Estate. Further downstream of Sackville, wetland formation is often limited by the presence of steep sandstone cliff formations.

FIGURE 3-4 LONGNECK LAGOON (SOURCE: NPWS)

The transition from freshwater wetlands to estuarine wetlands occurs just downstream of Wiseman's Ferry, and estuarine wetlands are common throughout the Lower Hawkesbury (BMT WBM, 2008). These estuarine wetlands are characterised by the presence of significant mangrove and saltmarsh communities, with swamp oak (*Casuarina glauca*), common reed (*Phragmites australis*) and paperbark (*Melaleuca quinquenervia*) found along freshwater margins higher up the estuary (Astles et al, 2010). Riparian vegetation in the catchment is dominated by stands of river oak (*Casuarina cunninghamiana*), with water gum (*Tristania laurina*) also present along the river and creek banks of the wetter and more protected areas (DPI, 2006). The largest estuarine wetlands are found at the confluence of Mangrove Creek and the Hawkesbury River, and along Marramarra Creek in Big Bay (Kimmerikong, 2005). Communities of mixed saltmarsh and mangroves are also found in Coba Bay, Peats Bight, Mangrove Creek opposite the junction to Popran Creek; end of Calna Creek and Calabash Bay in Berowra Creek and Piles Creek near the junction with Mooney Mooney Creek (ACUN, 2003). The area between Mooney Mooney and Brooklyn holds the three largest areas of seagrasses (south of Dangar Island, at the entrance to Brooklyn Harbour and entrance to Sandbrook inlet) in the Lower Hawkesbury in addition to small patches along the upper tidal area of Berowra Creek and the various arms of Cowan Creek.

The Brisbane Water Estuary contains a range of seagrass, mangrove and saltmarsh habitats. It contains over 500 ha of seagrass habitats that form meadows in the soft sediments of the near-shore estuarine waters (CLT, 2008). The most common species across the estuary are Eelgrass (*Zostera capricorni*), Paddleweed

(*Halophila australis.*), and Strapweed (*Posidonia australis*). *Zostera* and *Posidonia* are prevalent across Kincumber, Cockle Bay and Cockle Channel, whilst large communities also exist across Riley's Island and The Broadwater. *Halophila* is the least prevalent in terms of spatial coverage (CLT, 2008), and is generally confined to Wagstaffe Point in the vicinity of the entrance shoals.

FIGURE 3-5 POSIDONIA AUSTRALIS (SOURCE: DPI)

Large communities of mangrove forests exist around Riley's Island and Pelican Island, which are largely undeveloped and undisturbed. Mangrove communities also exist at the north-eastern corner of the Broadwater, near Erina, and within the Fagans Bay Inlet and Narara Creek. Saltmarsh communities occur along the major creeks and are generally fringed by Estuarine Swamp Forest dominated by swamp oak, with an understorey of sedges and rushes (CLT, 2008).

The riparian and fringing terrestrial vegetation of the Pittwater estuary consists of remnant urban bushland and riparian vegetation on the eastern side of the estuary, and extensive Eucalypt bushland areas along the western shoreline within Ku-ring-gai Chase National Park (L&T, 2003). Table 3-7 shows a relative scarcity of mangroves and saltmarsh within the Pittwater Estuary, which can be attributed to a lack of suitable substrate, reflecting the steep topography and limited tidal flat development in the estuary (L&T, 2003). Nonetheless, the largest mangrove areas occur in Careel Bay and McCarrs Creek, with smaller areas recorded at the head of several embayments. The primary habitat throughout the estuary is that of seagrass. *Zostera* is most common along shallow areas of Barrenjoey Beach and Careel Bay, and in small isolated patches in other parts of the estuary. *Posidonia* is generally found in the deeper waters adjoining *Zostera*, while narrow beds also exist around Clareville, Bayview, Church Point, Scotland Island, Elvina/Lovett Bays, and the north-west shoreline of Pittwater (adjacent to and south of Great Mackerel Beach). *Halophila* generally forms mixed assemblages with Zostera and Posidonia throughout the estuary (L&T, 2003).

A high-level assessment of study area fauna was undertaken through interrogation of the national "Protected Matters Search Tool" developed by the Department of Environment and Energy (accessed on the 26/09/2019). The search showed a number of vulnerable and endangered ecological communities (EECs), including:

- Blue Gum High Forest of the Sydney Basin Bioregion
- Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion
- Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community
- Coastal Upland Swamps in the Sydney Basin Bioregion
- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia
- Posidonia australis seagrass meadows of the Manning-Hawkesbury ecoregion
- Shale Sandstone Transition Forest of the Sydney Basin Bioregion
- Subtropical and Temperate Coastal Saltmarsh
- Turpentine-Ironbark Forest of the Sydney Basin Bioregion
- Western Sydney Dry Rainforest and Moist Woodland on Shale

The study area also contains over 59 vulnerable plant species, such as the Magenta Lilly Pilly (*Syzygium paniculatum*) and the Tranquility Mintbush (*Prostanthera askania).*

Fauna

The extensive range of aquatic and riparian habitat across the estuary system supports a diverse assemblage of species. The entire Hawkesbury-Nepean catchment is known to contain over 1,100 native vertebrates (including fish, amphibians, reptiles, birds and mammals) and 1,700 invertebrates (HNCMA, 2005).

This includes over 160 species of fish (DLWC, 1997; WRL, 2003). The native fish populations within the system comprise potamodromous species that undertake migration wholly within freshwater systems, catadromous species which migrate between freshwater and sea, and amphidromous species, that complete non-breeding migrations between freshwater and sea (DPI Fisheries 2006; Harris et al., 1994).

FIGURE 3-6 BLACK ROCKCOD (SOURCE: DPI)

Of these native species, a number are listed as threatened. Important indigenous freshwater fish species found within the upper estuary include the Macquarie perch (*Macquaria australasica*), and the Australian grayling (*Prototroctes maraena)*. Notable threatened estuarine species, including the Black Rockcod (*Epinephelus daemelii*, see Figure 3-6) are also known to occur in the Hawkesbury River estuary (BMT WBM, 2013a). Both of these species have been affected by threats such as introduced species, as well as other factors such as reduced water quality, increased fishing pressure, and habitat degradation (BMT WBM, 2014a; DPI Fisheries 2006). The White's Seahorse (Hippocampus whitei) is also listed as threatened and has recorded populations within Brisbane Water. The region also supports an array of aquatic macroinvertebrates including insects, prawns, crayfish, native oysters and freshwater mussels.

A high-level assessment of study area fauna was undertaken through interrogation of the national "Protected Matters Search Tool" developed by the Department of Environment and Energy (accessed on the 26/09/2019). The search returned over 60 threatened species records including:

- 36 vulnerable species of birds, including the Curlew Sandpiper (*Calidris ferruginea*) and Eastern Curlew (*Numenius madagascariensis*);
- 14 species of mammals, such as the Spot-tailed Quoll (*Dasyurus maculatus*) and the Southern Brown Bandicoot (*Isoodon obesulus*);
- 6 species of reptile such as the Green Turtle (*Chelonia mydas*) and 6 species of frogs including the Green and Golden Bell Frog (*Litoria aurea*); and
- 3 vulnerable fish species (as discussed above).

The Broken Bay area hosts a number of marine mammals such as Australian and New Zealand Fur seals and seasonally a variety of whales.

All these species are dependent on healthy waterways and access to a range of diverse aquatic habitats for their survival. A number of bird surveys, including migratory birds, have been undertaken by Councils and volunteer groups like Bird Life Australia (P&J Smith, 2012). Active conservation and habitat protection is undertaken in numerous parts of the catchment, including the national parks and nature reserves managed by NPWS.

The CMP should not only consider habitats and species that are known to occur but also identify opportunities to support both marine and terrestrial species that could potentially utilise the study area.

3.2.5 Climate Change

Climate change will affect the natural, social and economic welfare of NSW (Adapt NSW, 2019). There are a number of impacts associated with climate change that are projected to affect the Hawkesbury-Nepean River system and its contributing catchment. These include:

- **Mean sea level rise**: Global sea levels are rising and increasing the risk to coastal communities from inundation and erosion. The current rate of mean sea level rise is estimated at around 3mm/year (White, 2014), with projected sea levels expected to increase by between 0.23m and 0.88m by 2090 (CoastAdapt, 2018a), depending on future emission pathways. Further detail around sea level rise projections is given in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (IPCC, 2013).
- **Floods and Storms**: The frequency and intensity of floods and storms are likely to be affected by climate change (IPCC, 2013). Rainfall extremes are projected to increase throughout the 21st century, whilst the frequency and intensity of east coast lows is also expected to change, which in turn will affect water resources along the catchments of the northern NSW coastline.
- **Ocean/estuarine Impacts**: In addition to sea level rise, climate change is expected to result in changes to the air temperature, water quality (Temperature, Salinity ,Turbidity, Suspended Solids) and chemistry (Oxygen, nutrients, pH and alkalinity, Chlorophyll-a) of coastal and estuarine systems. This will also impact on heat budget; hydrodynamic and mixing in particular after rainfall; effect on sediment dynamics (WRL, 2019). This includes ocean acidification and the impacts of warmer oceans on soft coral and fisheries.
- **Water Resources**: Climate change is projected to impact the hydrological system through changes in rainfall regimes, groundwater recharge and surface runoff. This is projected to result in a number of flow-on effects including impacts to salinity, erosion, water quality and aquatic biodiversity. Altered rainfall and drought regimes may place additional strain of water extraction - threatening water availability, access, and even quality.
- **Heat**: Heatwaves are a significant hazard, and have been responsible for more human deaths in Australia than any other natural hazard (Adapt NSW, 2019). Temperatures in NSW are projected to increase across the 21st century. Apart from human health impacts, changes in heat have the potential to affect a number of other important systems including emergency management, infrastructure, transport, primary industries and the environment (Adapt NSW, 2019).
- **Bushfires**: Climate projections show that much of southern Australia may become warmer and drier, and as a result is likely to bring an increasing bushfire risk. The NSW Government estimates that, by 2050, extreme fire danger days in south-eastern Australia may occur 5 to 65 per cent more frequently than at present (Adapt NSW, 2019).
- **Biodiversity**: Rising air and ocean temperatures, increased sea levels, potential changes in fire regimes, water quality and ocean chemistry will have wide-ranging impacts on biodiversity and pose a serious threat to native species and ecosystems (Adapt NSW, 2019). This may intensify existing threats such as habitat loss, weeds, pest animals and drought. Coastal wetlands, salt marshes, and mangroves are highly vulnerable to inundation as sea levels rise, unless they can migrate inland unimpeded. More frequent droughts in upland and coastal areas may also reduce the flow of freshwater into these brackish ecosystems, contributing to marsh dieback and shoreline retreat.

A summary of projected climate change impacts as supplied by NSW Adapt is provided in Figure 3-7.

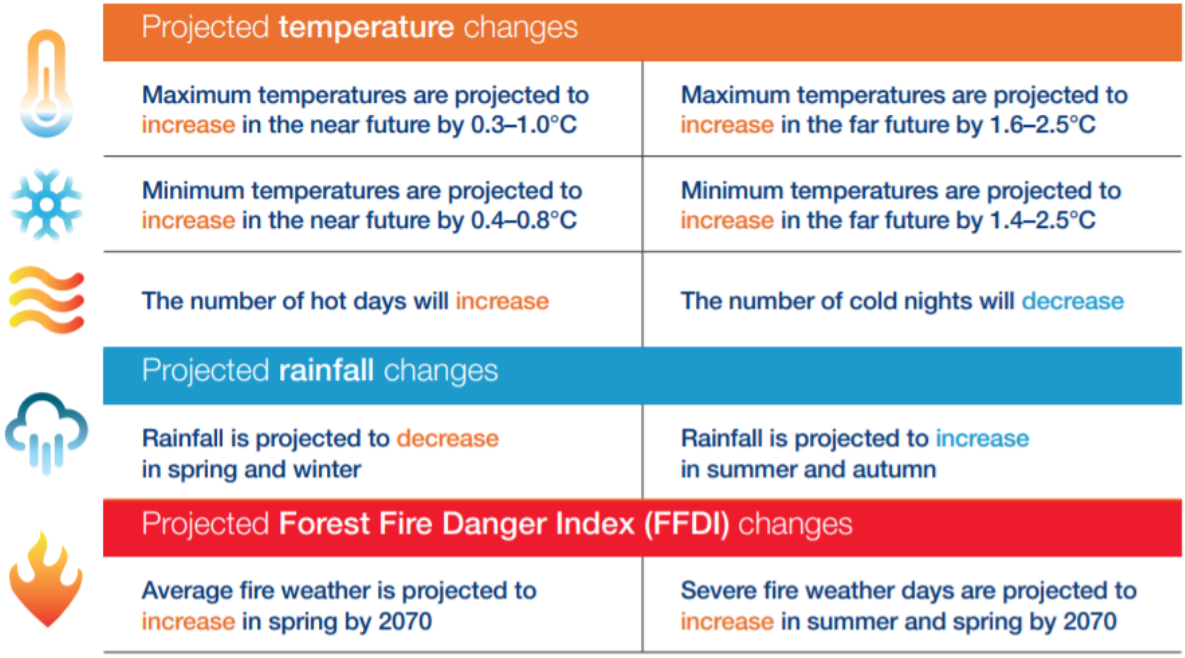


FIGURE 3-7 PROJECT COAST CLIMATE CHANGE IMPACTS FOR THE SYDNEY REGION (NSW ADAPT, 2019)

3.3 Governance Context

One of the objectives of the CMP is to facilitate the integration of management responsibilities across the Hawkesbury-Nepean River catchment, including local councils, land managers and public authorities. In order to develop a robust CMP that achieves its intended objectives now and into the future, it will be necessary to have an in-depth understanding of historical estuary management arrangements for the Hawkesbury-Nepean catchment, including the roles and responsibilities of the various agencies managing the different areas of the system (including Brisbane Water and Pittwater).

The current governance of the system is multi-layered, with the waterways and foreshores of the study area (and associated assets) owned and managed by a wide variety of stakeholders across multiple levels of government. As a result, some jurisdictional ambiguity exists across the estuaries and their respective catchment. It is important to note that there is presently no lead organisation (as either a single entity or collective) to oversee the management of Hawkesbury-Nepean River system.

3.3.1 Local Government

There are six (6) local government areas that border the tidal waterways of the estuary, and an additional eighteen (18) local government areas encompassing the wider Hawkesbury-Nepean River Catchment (either wholly or partly). These are listed in Table 3-8.

TABLE 3-8 LOCAL GOVERNMENT AREAS INTERSECTING THE STUDY AREA CATCHMENTS

Council*	Pittwater Estuary	Hawkesbury River Estuary	Brisbane Water Estuary	Foreshore / Catchment Council
Central Coast Council		✓	✓	***Foreshore***
Hawkesbury City Council		✓		***Foreshore***
The Hills Shire Council		✓		***Foreshore***

Council*	Pittwater Estuary	Hawkesbury River Estuary	Brisbane Water Estuary	Foreshore / Catchment Council
Hornsby Shire Council		✓		***Foreshore***
Ku-ring-gai Council		✓		***Foreshore***
Northern Beaches Council	✓	✓		***Foreshore***
Blacktown City Council		✓		Catchment
Blue Mountains City Council		✓		Catchment
Camden Council		✓		Catchment
Campbelltown City Council		✓		Catchment
Cessnock City Council		✓		Catchment
Fairfield City Council		✓		Catchment
Goulburn Mulwaree Council		✓		Catchment
Lithgow City Council		✓		Catchment
Liverpool City Council		✓		Catchment
Mid-Western Regional Council		✓		Catchment
Oberon City Council		✓		Catchment
Penrith City Council		✓		Catchment
Queanbeyan-Palerang Regional Council		✓		Catchment
Singleton Council		✓		Catchment
Upper Lachlan Shire Council		✓		Catchment
Wingecarribee Shire Council		✓		Catchment
Wollondilly Shire Council		✓		Catchment
Wollongong City Council		✓		Catchment

* Partner Councils for the CMP are depicted in ***Bold-Italic*** font.

An overview of the range of council roles and responsibilities as they relate to the CMP is provided in Table 3-9 below. Council responsibilities generally relate to management of catchment and estuarine issues, coastal zone land and assets, and strategic planning.

TABLE 3-9 OVERVIEW OF ROLES AND RESPONSIBILITIES OF COUNCILS ACROSS THE COASTAL ZONE

Issue Management	Land and Asset management	Planning
▪ Coastal, estuary and waterway management ▪ Water quality monitoring and research ▪ Floodplain and flood risk management ▪ Vegetation protection and management	▪ Coastal and estuary infrastructure ▪ Stormwater and drainage infrastructure ▪ Road, traffic and parking infrastructure ▪ Open space and community assets	▪ Strategic Planning - including implementation of regional strategies, development of Community Strategic Plans (CSP's) and Local Strategic Planning Statements (LSPS) and other strategies ▪ Development and implementation of planning

Issue Management	Land and Asset management	Planning
▪ Fauna protection and conservation ▪ Catchment management ▪ Community Events ▪ Community consultation, engagement and education ▪ Cultural Heritage ▪ Recreational use of the estuaries and waterways ▪ Compliance and education activities (environmental and development) ▪ Bushfire planning and management	▪ Management of beaches and beach access ▪ Management of foreshore parks and access (including waterway access) ▪ Management of bushland reserve ▪ Management of WWTPs and in some cases Water Supply	controls (including LEPs and DCP's) ▪ Implementation of IP&R framework ▪ Development and implementation of CMP's

Councils are responsible for the management of estuarine and catchment assets that include estuary infrastructure (such as breakwaters, boat ramps and seawalls), stormwater and drainage infrastructure, open space assets and foreshore and coastal access points. These can also include water resource assets such as dams – such as Mangrove Creek, Mardi and Mooney Mooney dams which are owned and operated by Central Coast Council.

Councils also manage a range of issues across the study area including, cultural heritage, community events, recreational use of the estuaries and foreshore, estuary and floodplain management, and flora and fauna protection & conservation. Many Councils undertake water quality monitoring, as described in Section 6.3.

Councils are also responsible for development planning and controls across their respective LGAs. The objective of their development planning and controls is to achieve development that is consistent with the social, economic and environmental values of the estuaries and their catchments - and to manage the cumulative impact of development in a sustainable manner. Further information regarding the roles of local councils in strategic planning and relevance to the CMP process is provided in Section 3.5.5.

With regards to CMP development and implementation, the relevant roles and responsibilities of the upper catchment councils are generally in relation to waterway management, and management of agricultural run-off, urban stormwater discharge and industrial discharges.

3.3.2 State Government

There are over twenty state government agencies with management roles and responsibilities across the study area that are relevant to the CMP. These agencies are spread across four (4) separate government departments (or clusters). These agencies and their position within the wider NSW state government organisational structure are depicted in Figure 3-8. Some of these agencies have a land and asset management role, whilst others are issues based. A brief summary of the roles and responsibilities of the most relevant state government departments and agencies is provided herein.

Most of the NSW government stakeholders for the CMP sit within the NSW Department of Planning, Industry and Environment cluster. However, there are also a number of other state government agencies and organisations outside of this department that share management and planning responsibilities across the catchment system - including those from the Sydney Water, WaterNSW, the Department of Transport, Department of Premier and Cabinet, and the Department of Community Services and Justice.

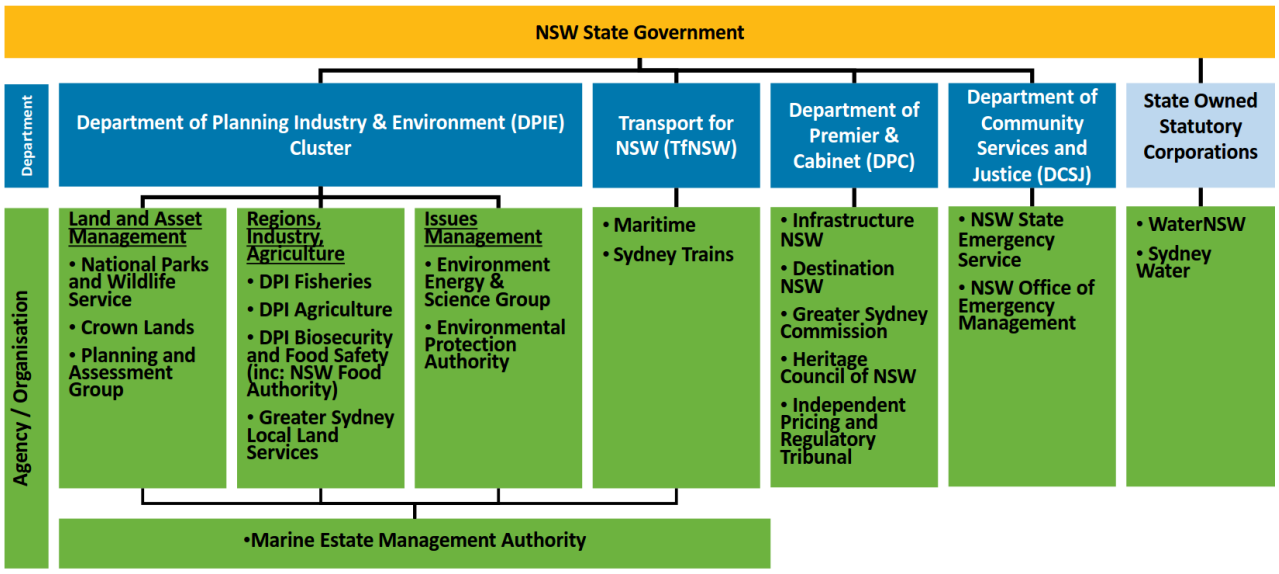


FIGURE 3-8 NSW STATE GOVERNMENT AGENCIES RELEVANT TO THE CMP

The NSW Coastal Council provides independent expert advice to the Minister administering the CM Act 2016 on coastal planning and management issues, when requested by the Minister to do so. The Council was appointed under the CM Act 2016, and replaced the NSW Coastal Panel and the Coastal Expert Panel. The Minister can request the NSW Coastal Council to audit a local council's implementation of its coastal management program to determine if it is being effectively implemented.

The NSW Department of Planning, Industry and Environment Cluster

Many of these CMP stakeholder organisations are positioned within the NSW Department of Planning, Industry and Environment (DPIE), and their responsibilities across the study area relate to land and asset management, issues management, and planning and assessment. Within DPIE, the *Environment, Energy and Science Group* (EES), has absorbed the responsibilities of the former Office of Environment and Heritage. DPIE (EES) is responsible for administering the CM Act, and provide oversight of the State's coastal management program. DPIE (EES) provides oversight in the development of each council's CMPs, and also provide data and technical advice as needed. It also administers the Coastal and Estuary Grants Program that provides funding for councils to prepare and implement their CMPs.

The Department of Planning, Industry & Environment - Crown Lands (DPIE - Crown Lands) is responsible for the administration and/ or management of Crown land under the *Crown Land Management Act 2016*. Crown land includes submerged Crown land, seabed and subsoil to three nautical miles from the coastline of NSW that is within the limits of the coastal waters of the State. Crown land includes much of the submerged land within the estuaries and intertidal areas (below mean high water mark) of the study area, as well as several foreshore reserves and beaches (for example Patonga Beach, Pearl Beach and Umina Beach). Several of the coastal Crown reserves and foreshores in the study area are under the management of Central Coast Council.

Crown Lands licences domestic waterfront structures that occupy Crown land, such as jetties and pontoons. The department also licences commercial marinas and other maritime facilities. Crown Lands' current functions include the Coastal Infrastructure Program (CIP). The CIP is responsible for managing state owned infrastructure such as coastal harbours, ocean entrances and estuary training walls - this includes several assets within Brooklyn Boat Harbour. The CIP also delivers the Rescuing Our Waterways dredging program and the NSW Coastal Dredging Strategy. The CIP is part of the Maritime Infrastructure Delivery Office (MIDO). On 1 July 2020, the programs and functions of the MIDO that are currently undertaken by Crown Lands, are expected to be transferred to Transport for NSW.

NSW National Parks and Wildlife Service (NPWS) is responsible for management of the National Parks and Wildlife Act 1974 and management of nineteen different reserves and parks across the study area – including those listed in Table 3-10 below. These parks have direct water frontages and often provide infrastructure such as boat ramps, walking tracks, and visitor amenities. NPWS responsibilities across the areas involves a wide range of activities, including active conservation and habitat protection, fire management, management of tourism and visitation, research and, education. It is also responsible for management and protection of Aboriginal cultural heritage and European heritage across its land tenure.

FIGURE 3-9 DHARUG NATIONAL PARK (SOURCE: NPWS)

TABLE 3-10 NATIONAL PARKS INTERSECTING THE HAWKESBURY-NEPEAN CATCHMENT

National Parks Managed by NPWS within Study Area		
▪ Berowra Valley National Park	▪ Long Island Nature Reserve	▪ Rileys Island Nature Reserve
▪ Bouddi National Park	▪ Marramarra National Park	▪ Rouse Hill Regional Park
▪ Brisbane Water National Park	▪ Mulgoa Nature Reserve	▪ Saratoga Island Nature Reserve
▪ Cattai National Park	▪ Muogamarra Nature Reserve	▪ Scheyville National Park
▪ Cockle Bay Nature Reserve	▪ Parr State Conservation Area	▪ Spectacle Island Nature Reserve
▪ Dharug National Park	▪ Pelican Island Nature Reserve	▪ Wisemans Ferry Historic Site
▪ Ku-ring-gai Chase National Park	▪ Pitt Town Nature Reserve	▪ Yengo National Park
▪ Lion Island Nature Reserve	▪ Popran National Park	

Department of Primary Industries - Fisheries is responsible for administering the *Fisheries Management Act 1994* and ensure decisions made about land management and development avoids and minimises impacts on fisheries resources. Its responsibilities also include the licensing of recreational fishers, enforcement of bag limits, and permits for commercial fishing activities. They are responsible for threatened species conservation and marine vegetation protection (including mangroves, saltmarsh and seagrass) across the waterways of the study area. Fisheries also administer the Marine Estate Management Act in coordination with the NSW Marine Estate Management Authority (MEMA).

The Marine Estate Management Authority (MEMA) advises the NSW Government on the management of the NSW marine estate, and coordinates policies and programs for maintaining and improving the marine environment. The Authority brings together the heads of the NSW Government agencies with key marine estate responsibilities – including DPIE (Planning, EES, and Fisheries) and TfNSW (MEMA, 2019).

Department of Primary Industries – Agriculture is responsible for increasing the productivity and resilience of the agricultural sector in NSW. It does this through agricultural productivity research across livestock, plants and natural resource management areas, as well as providing education and training.

Greater Sydney Local Land Services (LLS) was established under the *Local Land Services Act 2013* to provide quality, customer-focused services to landholders and the community across NSW. Greater Sydney LLS provides natural resource management, agricultural production advice, biosecurity, and emergency management functions across the Greater Sydney region (LLS, 2019). On January 1, 2014 Greater Sydney Local Land Services replaced the Hawkesbury-Nepean Catchment Management Authority.

The NSW Environment Protection Authority (EPA) is the primary environmental regulator for New South Wales. Councils, Sydney Water and other organisations hold a number of environment protection licences issued by the NSW EPA under the *Protection of the Environment Operations Act 1997*. These licences generally relate to Wastewater Treatment Plants, Landfill Sites and Quarries, and Disused Landfill Sites Under Remediation.

The NSW Food Authority (NSWFA) is responsible for food safety and consumer food protection across the state. It licences approximately 300 businesses in the shellfish sector across the state - made up of around 270 oyster farmers and 30 shellfish wild harvest businesses (NSWFA, 2019). Their other core responsibility in relation to the CMP is the development of harvest area management plans for commercial shellfish cultivation and harvesting. It sits within DPIE under the DPI Biosecurity and Food Safety Branch.

Transport for NSW

The Transport cluster comprises Transport for NSW (TfNSW) and an extended network of other agencies. TfNSW sets the strategic direction for transport and works in partnership with government transport operating agencies and private service providers to deliver improved transport outcomes for the community and economy of NSW.

Maritime sits within TfNSW as New South Wales' maritime safety regulator for commercial and recreational vessels and their operators. Maritime's role within TfNSW is to promote safe, responsible and sustainable use of waterways, including but not limited to the enforcement of safe on-water vessel practices, the administration of recreational vessel licenses and vessel registrations, and provision of guidance for safe navigation.

It is also responsible for the direct delivery of a number of maritime infrastructure projects as well as investment in many others across the state. Other responsibilities include property administration, policy development, strategic planning and infrastructure management related to commercial and recreational boating – including some of the boat ramps and public jetties, wharves and pontoons across the study area (noting that most boat ramps are owned and managed by councils).

The Maritime Infrastructure Delivery Office (MIDO) sits within Maritime and is a joint initiative between the former agencies of Roads and Maritime Services and the Department of Industry to improve the coordination and delivery of coastal and boating infrastructure programs and projects across NSW that support recreational boating, fishing, tourism and a range of other commercial activities. The MIDO is responsible for delivering key projects and programs including TfNSW's Boating Now Program, DPIE's Coastal Infrastructure Program, Rescuing our Waterways dredging program and a number of major projects including the La Perouse to Kurnell Ferry Wharf and Eden Safe Harbour projects.

Sydney Trains is the operator of rail services across the Sydney metropolitan area, bounded by Berowra, Emu Plains, Macarthur and Waterfall. Sydney Trains also operate the Rail Operations Centre and are responsible for the maintenance of assets including tracks, trains, signals, overhead wiring, stations and facilities. Sydney Trains also maintains the trains and a large proportion of the infrastructure used by NSW TrainLink including Main Northern Line from Sydney To Newcastle which crosses the Hawkesbury River from Brooklyn to Cogra Bay and continues adjacent to Mullet Creek for 6 kilometres.

NSW Department of Premier and Cabinet

Infrastructure NSW (INSW) acts as an advisor to the NSW Government on the State's infrastructure needs and priorities. It is responsible for preparing the State Infrastructure Strategy, and also provides technical advice and direction regarding large scale infrastructure management. Importantly, the Hawkesbury-Nepean Valley Flood Risk Management Directorate is based within INSW, and is responsible for oversight and implementation of the Hawkesbury-Nepean Valley Flood Risk Management Strategy.

The Greater Sydney Commission (GSC) acts to coordinate and align long term strategic planning for the Greater Sydney region, and is responsible for development of the Greater Sydney Strategic Plan (see Section 3.5.4).

The Heritage Councils of NSW (HCNSW) is an independent statutory body that works to ensure the protection, preservation and promotion of heritage in NSW (OEH, 2019b). The Heritage Council has a management role in the protection of state significant heritage places and items.

The Independent Pricing and Regulatory Tribunal of New South Wales (IPART) is the independent pricing regulator for water in NSW. It reviews and determines the maximum prices that can be charged for bulk and retail water by most major water utilities across NSW. It also makes recommendations about public utility and alternate water utilities and monitor all utilities' licence compliance (IPART, 2019). IPART is responsible for reviewing Sydney Water's operating licence every 5 years.

NSW Department of Community Services and Justice

The NSW State Emergency Service major responsibilities are for provision of emergency and rescue services during times of natural hazard emergencies and disasters - including flooding, storms (including storm tide and severe erosion events), and tsunami events. It also promotes flood risk awareness and preparedness across the Hawkesbury-Nepean Valley.

The NSW Office of Emergency Management (OEM) leads, coordinates and develops capability in the emergency management sector, and conducts state-wide welfare and recovery operations when disaster strikes (OEM, 2019).

There are two Sport and Recreation Centres in the study area that are managed by the NSW Office of Sport. These offer camp sites for outdoor and environmental experiences. The two centres are Milson Island Sport and Recreation Centre and Broken Bay Sport and Recreation Centre (Patonga).

NSW Department of Education

There are four Environmental Education Centres managed by the NSW Department of Education across the study area. These Centres run field study school excursions to local river, coast and estuary environments. The study area is unique in that nowhere else in the state has this concentration of Environmental Education facilities. The four Centres are:

- Brewongle Environmental Education Centre (Sackville)
- Long Neck Lagoon Environmental Education Centre (Pitt Town)
- Gibberagong Environmental Education Centre (Bobbin Head)
- Rumbalara Environmental Education Centre (Gosford)

State Owned Statutory Corporations

WaterNSW is a state-owned corporation established under the *Water NSW Act 2014* and operates under an Operating Licence issued and monitored by the Independent Pricing and Regulatory Authority. WaterNSW has a major role in the Hawkesbury-Nepean catchment through its catchment management and its raw drinking water supply functions. WaterNSW owns and manages 11 drinking water supply dams in the upper catchment including Warragamba Dam and has the function of protecting and enhancing the quality of water in the catchments of these dams. WaterNSW has a comprehensive program in place to manage water quality in the upper catchment. WaterNSW extracts water from the upper catchment in accordance with the requirements of the Greater Sydney Metropolitan Region Unregulated River Water Sources 2011 Water Sharing Plan. The Plan requires WaterNSW to release specified quantities of water from most of its dams for the purposes of environmental flows benefiting the lower catchment.

Sydney Water is statutory state owned corporation (wholly owned by the New South Wales Government) that provides potable drinking water, wastewater and some stormwater services to over 5 million people across the Greater Metropolitan Sydney, the Illawarra and the Blue Mountains regions (Sydney Water, 2019). Sydney Water operates 16 wastewater treatment plants across the Greater Sydney area, of which 7 are located within the Hawkesbury-Nepean Catchment (see Section 3.2.2). They also own an operate14 water recycling plants (7 of which are within the study area catchment). Each system has an Environment Protection Licence (EPL) regulated by the NSW (EPA).

Local Aboriginal Land Councils

Darkinjung, Deerubbin and Metropolitan *Local Aboriginal Land Councils* (LALC) have a degree of governance and interface with council, as well as the various State and Federal Government bodies. LALCs have a right to be informed in the planning, protection and preservation of cultural sites and areas under the *NSW Aboriginal Land Rights Act 1983* on land within their boundaries. LALCs aim to achieve long term economic and social solutions for the indigenous communities, and to conserve and maintain cultural and heritage land management. Additional LALCs exist across the upper catchment of the study area.

3.3.3 Federal Government

Federal government roles and responsibilities are relatively minimal in the CMP. Across the wider Hawkesbury-Nepean Catchment, a major agency is the federal Department of Agriculture, which is responsible for development and implementation of national policies and programs to support agriculture, fisheries, and food industries and the productive management of rivers and water resources.

The Federal Government is also responsible for administering the *Environment Protection and Biodiversity Conservation Act, 1999* as it relates to various federally listed threated species and ecological communities occurring within the study area.

3.3.4 Non-governmental Organisations

There are a number of non-governmental organizations (NGOs) that operate across the wider Hawkesbury-Nepean waterways and catchment. These organisations include educational institutions such as universities, landcare and bushcare groups, and community and resident groups and businesses.

The stakeholder analysis undertaken in Section 4.3 depicts the vast array of community groups that exist across the study area.

3.3.5 Committees

Additionally, a number of relevant interagency committees operate across the study area at varying scales. For example, the Lower Hawkesbury Estuary Management Plan Committee (LHEMPC) which is comprised of representatives from elected councils, council staff, NSW government agencies, community and local industry groups. Members currently include Hornsby Shire Council, Central Coast Council, Hawkesbury City Council, and NSW Government agencies, including DPIE (NPWS, TfNSW, LLS, Fisheries) and Sydney Water. The committee also includes representatives of commercial fishing and boating groups, commercial oyster farmers, local marina operators and community groups. The committee's main objective is to improve the overall health of the estuary (HSC, 2019c).

Central Coast Council Catchments and Coast committee is an advisory committee focused on coastal and estuary management and flooding focused on the southern half of the Central Coast LGA (former Gosford). The purpose of the committee is to advise Council and staff on all matters relating to Council's responsibilities in relation to sustainable management of its coastal, estuarine, waterways, catchment and flood liable areas (CCC, 2019).

Hawkesbury River County Council (HRCC) is an inter-council organisation comprised of representatives of Blacktown, Hawkesbury, Penrith and the Hills Councils. It is a Local Control Authority under the *Biosecurity Act 2015*, and the purpose of the HRCC is to administer the Act throughout the LGAs of its member councils, for the control of declared priority weeds.

3.4 Policy Context

The legislation and policy governing the management of the Hawkesbury-Nepean River system is complex and includes acts and policies across all levels of government. A brief overview of the most relevant acts is provided herein for context.

3.4.1 Coastal Management Act 2016

As discussed in Section 1.2, the NSW Government has established a modern and integrated coastal management framework to better equip coastal communities to respond to existing and future coastal management challenges and opportunities. This included the introduction of the *Coastal Management Act 2016* (CM Act), and the State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP) which was commenced on 3 March 2018. The CM Act replaces the *Coastal Protection Act 1979*.

The CM Act establishes the framework and sets forth the objectives for coastal management in New South Wales. The purpose of the CM Act is to manage the use and development of the coastal environment in an ecologically sustainable way, for the social, cultural and economic well-being of the people of New South Wales (DPIE, 2019a).

The CM Act defines the coastal zone, comprising four coastal management areas (which are discussed further in Section 5):

- Coastal wetlands and littoral rainforests area
- Coastal vulnerability area
- Coastal environment area
- Coastal use area.

The CM Act establishes management objectives specific to each of these management areas, reflecting their different values to coastal communities.

Section 14(1) of the CM Act provides guidance for councils in the preparation of CMPs, specifically:

> *14 Preparation of coastal management programs*
>
> *(1) A local council is to prepare a coastal management program in accordance with the coastal management manual.*

The Coastal Management Manual sets forth mandatory requirements and provides guidance to coastal councils in connection with the preparation, development and implementation of CMPs.

3.4.2 State Environmental Planning Policy (Coastal Management) 2018

State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP) updates and consolidates into one integrated policy a series of previously enforced SEPP's, including: SEPP 14 (Coastal Wetlands), SEPP 26 (Littoral Rainforests) and SEPP 71 (Coastal Protection), including clause 5.5. of the Standard Instrument – Principal Local Environmental Plan.

The CM SEPP commenced on 3 April 2018 and gives effect to the objectives of the CM Act 2016 from a land use planning perspective, by specifying how development proposals are to be assessed if they fall within the coastal zone (DPIE, 2019a).

The CM SEPP streamlines coastal development assessment requirements, identifies development controls for consent authorities to apply to each coastal management area to achieve the objectives of the CM Act, and establishes the approval pathway for coastal protection works (DPIE, 2019a).

State-wide mapping that accompanies the CM SEPP is available for the coastal wetlands and littoral rainforest area, the coastal environment area, and the coastal use area. The mapping of coastal vulnerability areas is undertaken as part of CMP development, based on either existing coastal hazard mapping, or mapping to be developed during Stage 2 of the CMP.

3.4.3 Marine Estate Management Act 2014

The *Marine Estate Management Act 2014* (MEM Act) forms part of the NSW Marine Estate Management Framework. The framework comprises statutory instruments, strategies, assessment, plans and policy settings, and is administered under the auspices of the Marine Estate Management Authority (MEMA). The objective of the MEM Act is to provides for strategic and integrated management of the NSW marine estate, including the marine waters, coasts and estuaries. The key legislative instruments under the act include:

- Marine Estate Management Regulation 2017;
- Marine Estate Management (Management Rules) Regulation 1999; and,
- Aquatic Reserves Notification 2015.

It should be noted that one of the objectives of the CM Act (and of the CMP) is to support the objectives of the MEM Act 2014.

3.4.4 Additional Legislation and Policies

As of mid-2019, the NSW government has been working towards developing a new State Environmental Planning Policy (SEPP) for the protection and management of the natural environment. The Draft consolidated Environment SEPP is intended to simplify the planning rules for across catchments, waterways and urban bushland. The SEPP will consolidate and supersede the following seven (7) existing SEPPs:

- State Environmental Planning Policy No. 19 – Bushland in Urban Areas
- State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011
- State Environmental Planning Policy No. 50 – Canal Estate Development
- Greater Metropolitan Regional Environmental Plan No. 2 – Georges River Catchment
- Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River (No.2-1997)
- Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005
- Willandra Lakes Regional Environmental Plan No. 1 – World Heritage Property.

Additionally, a new planning framework for primary production and rural development commenced on 28 February 2019. The SEPP (Primary Production and Rural Development) 2019 supports NSW's agricultural sector, and simplifies the NSW planning system by consolidating, updating and repealing provisions in five former agriculture-themed SEPPs. Table 3-11 provides an overview of the key legislation and policy relevant to the management of the estuary.

The CMP will also need to consider the State Environmental Planning Policy (Sydney Region Growth Centres) 2006, which is the environmental planning instrument which sets controls for the North West and South West Growth Centres of Sydney.

TABLE 3-11 RELEVANT LEGISLATION

Legislation	Abbrev.	Administered By	Summary
Commonwealth			
Environment Protection and Biodiversity Conservation Act 1999	EPB&C Act	Department of Environment and Energy	The Act is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places.
Native Title Act 1993	NT Act	Department of Attorney General Minister for Indigenous Affairs	The act establishes a framework for the protection and recognition of native title, and enables DPIE to enter into indigenous land-use agreements. The parts of the NT Act relating to native title representative bodies and prescribed bodies corporate are administered by the Minister for Indigenous Affairs.
State (NSW)			
Aboriginal Land Rights Act 1983	ALR Act	Minister for Aboriginal Affairs NSWALC DPIE (Crown Lands)	The purpose of this Act is to provide land rights for Aboriginal persons in NSW, and to provide for representative Aboriginal Land Councils. The Act makes provision for claimable Crown lands and other dealings by Local Aboriginal Land Councils (LALC). It also provides for agreements to permit hunting, fishing and gathering by Aboriginal groups or persons. It is administered by the Minister for Aboriginal Affairs, but allocates roles, responsibilities and powers to The NSW Aboriginal Land Council (NSWALC) and DPIE (Crown Lands).
Biodiversity Conservation Act 2016	BC Act	DPIE (Environment)	The Act stipulates how development activities on land are regulated and how the impacts of these activities on the natural environment are managed. It is intended to conserve biological diversity and promote ecologically sustainable development.
Biosecurity Act 2015	BS Act	DPIE (GS LLS)	The BS Act came into effect on 1 July 2017. It aims to manage biosecurity risks from animal and plant pests and diseases, weeds and contaminants.
Coastal Management Act 2016	CM Act	DPIE	The CM Act establishes the framework and sets forth the objectives for coastal management in New South Wales. The purpose of the CM Act is to manage the use and development of the coastal environment in an ecologically sustainable way, for the social, cultural and economic well-being of the people of New South Wales (DPIE, 2019a).
Central Coast Water Corporation Act 2006	CCW Act	Central Coast Water Corporation	The Act defines the functions on the Central Coast Water Corporation. The purpose of the act is to promote the efficient delivery of water supply, sewerage and drainage services for the long-term interests of consumers with respect to price, quality, safety, reliability and security of supply.

Legislation	Abbrev.	Administered By	Summary
Crown Land Management Act 2016	CLM Act	DPIE (Crown Lands)	The Act requires that environmental, social, cultural heritage and economic considerations to be taken into account in decision-making about Crown land.
Environmental Planning & Assessment Act 1979	EP&A Act	DPIE Council	The Act requires relevant planning authorities to take into consideration the impacts to the environment (both natural and built) and the community of proposed development or land-use change.
Fisheries Management Act 1994	Fisheries Act	DPIE (Fisheries)	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. Related legal instruments include the Fisheries Management (General) Regulation 2010, the Fisheries Management (Supporting Plan) Regulation 2006, and the Fisheries Management (Estuary Prawn Trawl Share Management Plan) Regulation 2006.
Greater Sydney Commission Act 2015	GSC Act	The Greater Sydney Commission	The Act defines the functions on the Greater Sydney Commission, and provides for the formation of planning panels for the Greater Sydney Region.
Heritage Act 1977	Heritage Act	DPIE (Environment)	The Act provides for the conservation of environmental heritage items in NSW. It is intended to promote understanding and conservation of the state's heritage and provide for identifying and registering items of state heritage significance. The Act is complemented by the Heritage Regulation 2012.
Infrastructure NSW Act 2011	INSW Act	Department of Premier and Cabinet	The Act defines the functions on the Infrastructure NSW (INSW), and to enable the efficient, effective, economic and timely planning, co-ordination, selection, funding, implementation, delivery and whole-of-lifecycle asset management of infrastructure that is required for the economic and social well-being of the State.
Local Government Act 1993	LG Act	DPIE (Planning)	The Act provides the legal framework for the system of local government for New South Wales, and sets out the responsibilities and powers of councils, councillors and other persons and bodies that constitute the system of local government. DPIE administers Part 2A of Chapter 6 of the Act, which allows councils to make environmental upgrade agreements with development proponents. The Act is complemented by Local Government (General) Regulation 2005.
Local Land Service Act 2013	LLS Act	DPIE (Local Land Services)	The objective of the Act is to guide the management and delivery of local land services in the social, economic and environmental interests of the State. The Local Land Service Act 2013 requires the development of regional strategies to set the vision, priorities and strategy for the delivery of local land services in each region. The act is also the main piece of legislation for managing and protecting native vegetation on rural land.

Legislation	Abbrev.	Administered By	Summary
Marine Estate Management Act 2014	MEM Act	MEMA	The MEM Act forms part of the NSW Marine Estate Management Framework. The framework comprises statutory instruments, strategies, assessment, plans and policy settings, and is administered under the auspices of MEMA. The objective of the MEM Act is to provides for strategic and integrated management of the NSW marine estate, including the marine waters, coasts and estuaries.
Marine Safety Act 1998	MS Act	TfNSW	The purpose of the MS Act is to provide an effective framework for the enforcement of marine legislation, and is administered by TfNSW. The objects of the Act are to ensure the safe and responsible operation of vessels in ports and other waterways, so as to protect the safety and amenity of other users of those waters and the amenity of occupiers of adjoining land. It also aims to provide for the investigation of marine accidents and for appropriate action following any such investigation.
National Parks and Wildlife Act 1974	NPW Act	DPIE (NPWS)	The Act provides for the management of National Parks reserve land, including the conservation of nature, including habitat, ecosystems and heritage. It is the main piece of legislation for managing and protecting Aboriginal cultural heritage in NSW. The NPW Act is complemented by the National Parks and Wildlife Regulation 2009.
Natural Resources Commission Act 2003	NRC Act	DPIE (Planning)	The Act established The Natural Resources Commission - an independent body with broad investigating and reporting functions for the purposes of establishing a sound evidence basis for the properly informed management of natural resources in the social, economic and environmental interests of the State.
Ports and Maritime Administration Act 1995	PMA Act	TfNSW	The Act established statutory State owned corporations to operate the State's port facilities in the major ports; and to transfer waterways management and other marine safety functions to the Minister and Transport for NSW. The act is supported by the Ports and Maritime Administration Regulation 2012.
Protection of the Environment Operations Act 1997	POEO Act	DPIE (EPA)	The key piece of environment protection legislation administered by the EPA. The object of the Act is to achieve the protection, restoration and enhancement of the quality of the NSW environment.
Rural Fires Act 1997	RF Act	NSW RFS Local Councils	The purpose of the is to facilitate the co-ordination of bush fire fighting and bush fire prevention throughout the State. It is intended to enhance the protection of infrastructure and environmental, economic, cultural, agricultural and community assets from damage arising from fires.
State Emergency Service Act 1989	SES Act	Department of Community Services and Justice	The Act defines the functions on the NSW State Emergency Service.

Legislation	Abbrev.	Administered By	Summary
Water Management Act 2000	WM Act	DPIE (Industry) Water NSW	The object of the Act is the sustainable and integrated management of the state's water for the benefit of both present and future generations. The act is supported by the Water Management (General) Regulation 2018.
Water NSW Act 2014	Water Act	Water NSW	The object of the Act to ensure that declared catchment areas and water management works in such areas are managed and protected so as to promote water quality, the protection of public health and public safety, and the protection of the environment. The act is supported by the Water NSW Regulation 2013

3.5 Management and Planning Context

A number of coastal and estuary management plans guide management of the Hawkesbury-Nepean River system. Furthermore, there exist a number of planning instruments relevant to the governance of study area. These include:

- State Level Plans;
- Regional Level Plans; and
- Local Level Plans

A brief overview of these plans is provided below. A detailed list of additional studies, plans and strategies relevant to CMP development is provided in Appendix B.

3.5.1 Coastal and Estuary Management Plans

Over the years, several management studies and plans have been developed for the coastline and estuaries of the Hawkesbury-Nepean River system. These have been prepared in various forms, including Coastal Zone Management Plans (CZMPs) and Estuary Management Plans (EMPs). These documents have been developed over the last 20 years and cover a range of study areas within and across the estuary system. The most relevant, currently adopted studies and management plans are listed below:

TABLE 3-12 EXISTING COASTAL AND ESTUARY MANAGEMENT PLANS

Plan	Author	Year	Status	LGA's Covered
Upper Hawkesbury Estuary Coastal Zone Management Plan	BMT WBM	2014	Complete - Certified	The Hills Hawkesbury City
Lower Hawkesbury Estuary Management Plan	BMT WBM	2008	Complete	Central Coast Hornsby
Brisbane Water Estuary Coastal Zone Management Plan	Cardno	2012	Complete	Central Coast
Pittwater Estuary Management Plan	BMT WBM	2010	Complete	Northern Beaches
Gosford Beaches Coastal Zone Management Plan	Worley Parsons	2017	Complete - Certified	Central Coast
Pearl Beach Lagoon CZMP	BMT WBM	2017	Complete - Certified	Central Coast

Further detail regarding the content and implementation of these plans is provided in provided in Section 6.

3.5.2 National Plans and Strategies

The National Water Quality Management Strategy (NWQMS) is a Federal strategy to protect the nation's water resources through maintaining and improving water quality, while supporting dependent aquatic and terrestrial ecosystems, agricultural and urban communities, and industry (NWQMS, 2019). The purpose of the NWQMS is to develop a nationally coordinated framework (supported by all Australian governments) to facilitate water quality management. The objectives of the strategy are to ensure the productive and sustainable use of Australia's water resources, and to protect community values such as aquatic ecosystems. The CMP will need to ensure broad alignment with the objectives and guidelines of the NWQMS.

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality provide authoritative guidance on the management of water quality in Australia and New Zealand and provide a platform for consistent water quality management and planning across the nation. The National Water Quality Management Framework established as part of the guidelines sets out key requirements for long-term management strategies of riverine and estuarine water quality. The framework includes ten (10) steps that relate directly to water/sediment quality decisions and actions, and expands on the approach described in the National Water Quality Management Strategy charter – see Figure 3-10.

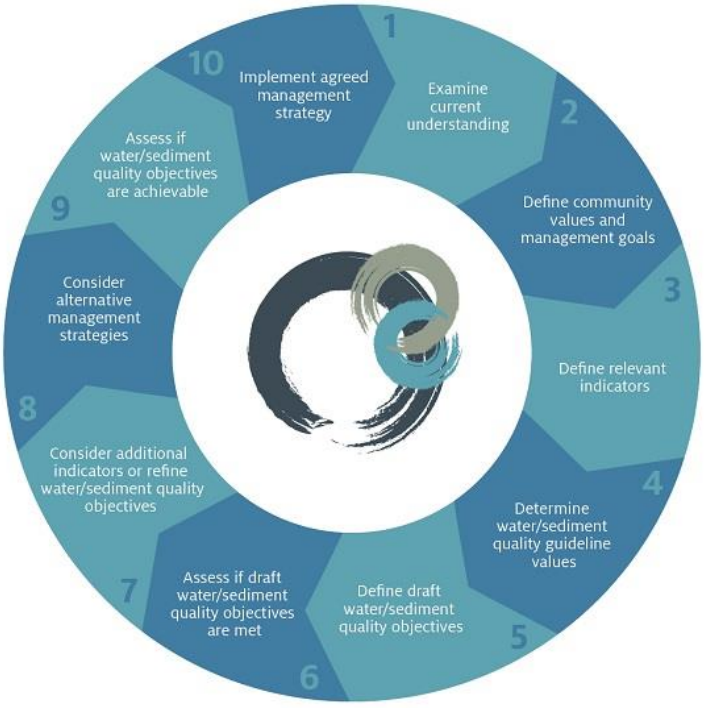


FIGURE 3-10 ANZ WATER QUALITY MANAGEMENT FRAMEWORK (SOURCE: NWQMS, 2019)

3.5.3 State Level Plans

The NSW State Plan 2021 is a 10-year plan that establishes the vision for state planning and outlines the framework to achieve the state's economic, health, transport, infrastructure and the environmental goals (DoP, 2011). The overarching goals and objectives of the plan provide direction for the development and implementation of the various regional and local plans and strategies outlined in Section 3.5.2 and 3.5.4 respectively.

The Sydney Regional Environmental Plan No 20 - Hawkesbury-Nepean River 1997 (SREP) is the primary State Planning Policy relating specifically to the Hawkesbury-Nepean River System and its surrounding foreshore and catchment. The aim of the 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. The Plan outlines specific planning policies and recommended strategies for the following issues:

- Total catchment management
- Environmentally sensitive areas
- Water quality
- Water quantity
- Cultural heritage
- Flora and fauna
- Riverine scenic quality
- Agriculture/aquaculture and fishing
- Rural residential development
- Urban development
- Recreation and tourism
- Metropolitan strategy

The NSW Marine Estate Management Strategy 2018-2028 (MEMA, 2018) provides an overarching, strategic approach to the coordination and management of the marine estate through to 2028. It sets the overarching framework for the NSW Government to coordinate management of the marine estate over the next decade in accordance with the objects of the MEM Act 2014 and the NSW Government's vision for the marine estate (MEMA, 2018). The Strategy responds to the priority threats to water quality, habitats and biodiversity of the State's coastal waters and estuaries that were identified in the NSW Marine Estate Threat and Risk Assessment (TARA) (BMT WBM, 2017). The management of priority threats is grouped into nine (9)

management initiatives that summarise the objectives, benefits, threats, stressors and proposed management actions. An implementation plan (developed by the Authority's member agencies in consultation with key stakeholders) articulates the management actions in more detail. Coastal Management Programs are key delivery mechanisms for the NSW Marine Estate Management Strategy (MEMS).

Progress towards implementing the MEMS and delivering its vision is measured and reported through the *NSW Marine Integrated Monitoring Program* (MIMP). The MIMP sets out a high-level approach for assessing progress against outcomes that management actions are expected to collectively achieve. Indicators will be used to provide quantifiable metrics for tracking performance towards outcomes (Aither, 2019). It is intended to guide monitoring, evaluation and reporting activities over the life of the MEMS. As per Aither (2019), the MIMP has three key purposes to:

- monitor the condition and trend of environmental assets and community benefits to inform a five-year health check;
- evaluate the effectiveness of management initiatives and actions that aim to reduce priority threats and risks; and
- fill knowledge gaps that were identified as part of the state-wide TARA process.

As part of the MIMP, an integrated monitoring and evaluation framework has been developed to assess the effectiveness of the Strategy in reducing priority threats and risks (point 2 above). This Framework was developed in collaboration with Marine Estate Management Authority agencies and the Marine Estate Expert Knowledge Panel (MEMA, 2020).

Recently, DPIE has developed the *Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions* (OEH, 2017) – see Figure 3-11. This framework presents a structured approach that decision-makers, such as councils and environmental regulators, can use to help manage the impact of land-use activities on the health of waterways in New South Wales. The framework brings together existing principles and guidelines recommended in the National Water Quality Management Strategy and allows decision-makers to determine management responses that meet waterway health outcomes - and reflect the community's environmental values and uses of waterways (OEH, 2017).

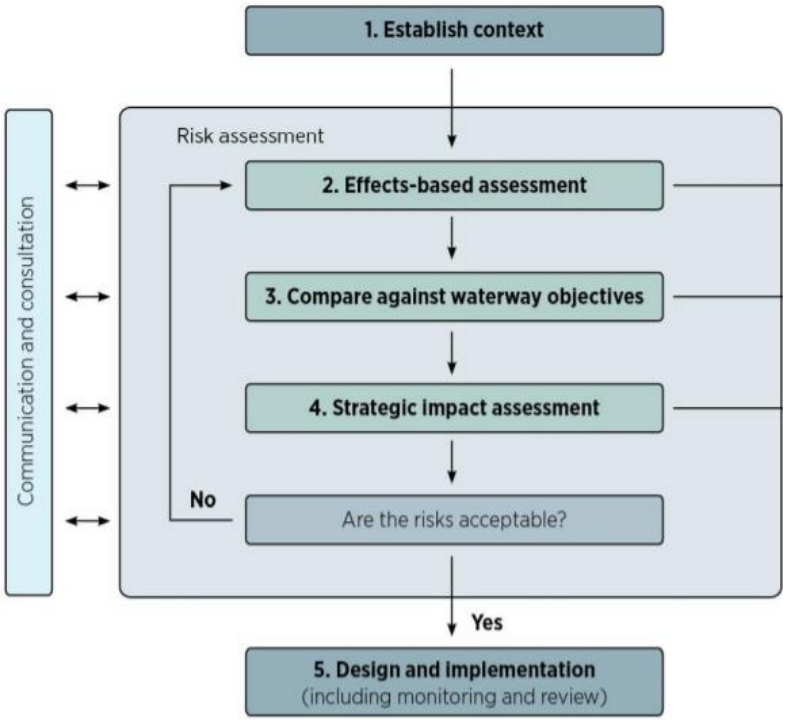


FIGURE 3-11 THE RISK-BASED FRAMEWORK (SOURCE: OEH, 2017)

The NSW Water Quality and River Flow Objectives (NSW Government, 1999) are agreed high-level goals for surface water flow management in NSW. The objectives set out 12 aspects of flow considered critical for the protection or restoration of river health, ecology and biodiversity. The objectives were subject to extensive public consultation and endorsed by the NSW Government in 1999. The objectives consist of three parts, following the recommended approach in the NWQMS: environmental values and uses, their indicators and their guideline trigger values.

The indicators and guideline trigger values are used to help assess whether a waterway will support a particular environmental value (OEH, 2017). These objectives are also complimented by the *Marine Water Quality Objectives* (DECW, 2006) which address coastal and marine waters and aim to simplify and streamline the consideration of water quality in coastal planning and management.

In November 2016, the NSW Government released the *NSW Climate Change Policy Framework*. It outlines the Government's role in reducing emissions, and helping NSW adapt and become more resilient to the impacts of climate change. The policy framework provides the strategic framework for NSW Government action on climate change and sets two objectives: to achieve net-zero emissions by 2050, and to make NSW more resilient to a changing climate.

The NSW Maritime Infrastructure Plan 2019-2024 (MIP), released in December 2018, sets out a strategic and coordinated approach to prioritising and delivering maritime infrastructure in NSW. The Plan aims to deliver better outcomes for residents, businesses and visitors by facilitating public and private sector investment in maritime infrastructure and facilities that best support the needs of commercial and recreational boaters, and enables broader economic and social benefits for communities. While supporting maritime infrastructure investment and delivery throughout NSW, the plan focuses primarily on key regional coastal ports and waterways. The plan identifies the Lower Hawkesbury River, Pittwater and Brisbane Water as key investment locations for future investment and outlines priority infrastructure outcomes required to support current demands and future growth of recreational boaters, the commercial fishing industry and tourism across the Hawkesbury River Estuary. Included in the MIP are the details of several state government and private funding programs and strategies, including the Boating Now Program.

Between 2015 and 2019, the Boating Now Program invested $70 million in new and upgraded boating infrastructure by providing support for maritime infrastructure owned by councils and other delivery partners. In October 2019, the NSW Government announced it is investing a further $28 million of funding to the Boating Now Program for the two year period from July 2020 to June 2022.

In 2019, the state government released the *NSW Coastal Dredging Strategy 2019-2024*. The purpose of the program is to adopt a strategic and proactive approach to dredging that delivers recreational boating benefits for local waterways in regional NSW. The strategy identifies the funding arrangements to support delivery of dredging projects to improve the accessibility and safety of regional coastal waterways (DoI, 2019a). As dredging is not a legislative responsibility, the Coastal Dredging Strategy has been developed and is coordinated by DPIE (Crown Lands). The Ettalong Channel at the mouth of the Brisbane Water Estuary is listed as a priority location for navigation dredging – see Figure 3-12.

FIGURE 3-12 ETTALONG CHANNEL DREDGING (SOURCE: DAILY TELEGRAPH)

The NSW Oyster Industry Sustainable Aquaculture Strategy 2016 (DPI, 2016) applies to the NSW edible oyster aquaculture industry and identifies areas within NSW estuaries where oyster aquaculture is a suitable and priority outcome. The Strategy promotes environmental, social and economic best practice for NSW oyster farming, and ensures that the principles of ecological sustainable development, community expectations and the needs of other user groups are integrated into the management and operation of the NSW oyster industry (DPI, 2016).

The NSW State Infrastructure Strategy (INSW, 2018) is a 20-year infrastructure investment plan for the NSW Government. The Strategy assesses infrastructure problems and provides recommendations to best grow the

State's economy, enhance productivity and improve living standards for the NSW community. It is updated every five years (INSW, 2018).

The NSW Flood Prone Land Policy is intended to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible (DIPNR, 2005).

The NPWS produces plans of management for each of the *National Parks* across the study area. The plans outline how reserves across the state will be managed, including information on natural environments, Aboriginal culture, historic sites, geographical landforms, biodiversity, weeds and pests, recreational opportunities and more (NPWS, 2019). It is expected that greater engagement with NPWS local Area Managers and local Rangers could provide pertinent information regarding values, uses and issues and how they may be considered in the CMP.

3.5.4 Regional & Catchment Level Plans

There are a number of existing regional and catchment scale plans across the Greater Sydney and Central Coast Regions. The CMP will need to align (where applicable) with the goals and objectives of these plans, and establish linkages with the management actions, roles and responsibilities in order to maximise system-wide benefits and improve coordination and collaboration across the region/catchment. A brief overview is provided below, with greater detail regarding linkages provided in Appendix C.

A Metropolis of Three Cities – the Greater Sydney Region Plan was developed by the Greater Sydney Commission, and outlines the overarching vision for the Greater Sydney Region. The plan sets a 40-year vision (to 2056) and establishes a 20-year plan to manage growth and change for Greater Sydney in the context of social, economic and environmental matters (GSC, 2018). It sets forth a vision for the region as a metropolis of three unique but connected cities in order to accommodate population growth with associated planning, land use, transport and infrastructure – see Figure 3-13. The plan outlines four (4) overarching goals of collaboration, liveability, productivity and sustainability with ten directions identified to deliver those goals. The Hawkesbury-Nepean River system CMP would align with several of these key directions. The plan includes five (5) district plans for the implementation at a district level, and three of these districts overlap with the study area catchment – the Western District, the Central District and the Northern district.

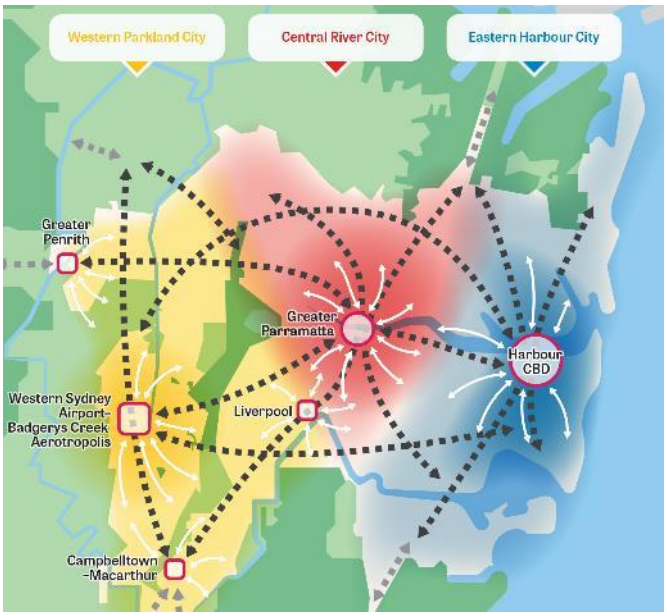


FIGURE 3-13 A METROPOLIS OF THREE CITIES – THE GREATER SYDNEY REGION PLAN (SOURCE: GSC, 2018)

Waterways are part of the green infrastructure that support the vision of plan (GSC, 2018). While two-thirds of Greater Sydney's urban areas are within coastal and harbour catchments, the most significant change in Greater Sydney is set to occur on the Cumberland Plain centred around South Creek which flows north into the Hawkesbury-Nepean River (GSC, 2018). The NSW Government is currently investigating different water recycling schemes and applications for both non-potable (for example, irrigation and industrial) and indirect potable (for example, replenishing groundwater systems) water reuse as part of the initiative.

In a similar vein, the *Central Coast Regional Plan 2036* sets regional planning priorities for the Central Coast and provides guidance and direction for regional and local planning decisions over a 20-year period to 2036 (DoP, 2017). It provides an overarching framework to guide land use planning, development proposals and infrastructure funding decisions. The plan outlines four (4) overarching goals of: A prosperous Central Coast with more jobs close to home; Protect the natural environment and manage the use of agricultural and resource lands; Well-connected communities and attractive lifestyles; and, A variety of housing choice to suit needs and lifestyles. The NSW Government has established the Central Coast Delivery, Coordination and Monitoring Committee to deliver, coordinate and be accountable for achieving the vision and goals of the Plan (DoP, 2017).

Greater Sydney Local Land Services Local Strategic Plan 2016-2021 sets the vision, priorities and overarching strategy for LLS across the Greater Sydney Region, with a focus on appropriate economic, social and environmental outcomes. The plan focuses on community engagement, setting and delivering local priorities, and determining how the priorities for LLS are best achieved at local level. The plan outlines a series of strategies through which the goals are to be achieved, through the improved management of biosecurity, natural resources, agricultural productivity and emergency management (LLS, 2016). The GS LLS Strategic Plan is intended to maintain and improve the resilience of the natural systems of the catchment and has a general focus on communities of the catchment and the ecosystem services provided to them by natural resources such as soils and land, native vegetation and aquatic ecosystems. Specific linkages between the CMP and the GS LLS Strategic Plan strategies are provided in Appendix C. The GS LLS Strategic Plan 2016-2021 superseded the Hawkesbury-Nepean Catchment Action Plan 2013-2023 (CAP). Development of the GS LLS Strategic Plan was therefore informed by the CAP, and whilst the CAP is a useful reference document, it is no longer an active planning tool.

The Lower Hawkesbury Nepean Nutrient Management Strategy (DECCW, 2010) provides an overarching framework for current and future nutrient management initiatives across the Lower Hawkesbury-Nepean River. The strategy is aimed at reducing nutrient loads from existing sources and limiting the growth in nutrient loads from changing land uses (DECCW, 2010). It provides an integrated catchment-wide framework to prioritise and coordinate action across different nutrient sources as well as involve the key state and local government bodies, industry and community stakeholders. The scope of the Strategy does not extend above the major water storages as the Sydney Catchment Authority already administers a significant strategic framework to manage water quality in the drinking water catchments (DECCW, 2010).

The Transport for NSW Regional Boating Plan for Hawkesbury River, Pittwater and Brisbane Water Region 2015 identifies boating safety, access and infrastructure actions for the Hawkesbury River Estuary to be implemented over the period 2015-2020 (TfNSW, 2015).

Other relevant regional and catchment level plans include:

- *Cumberland Plain Conservation Plan:* which is a conservation plan for Western Sydney to help balance the future needs of the community and protect threatened plants and animals in Western Sydney for the long term.
- *Resilient Valley, Resilient Communities – Hawkesbury-Nepean Valley Flood Risk Management Strategy* (INSW, 2017): which addresses flood risk from the Hawkesbury-Nepean River between Bents Basin, near Wallacia, and the Brooklyn Bridge.
- *Water Sharing Plan Greater Metropolitan Region Groundwater Sources* (NSW Office of Water, 2011): which provides a legislative basis for sharing water between the environment and consumptive purposes across the Greater Sydney Region
- *The Hawkesbury Destination Management and Action Plan 2017-2021* (Destination NSW, 2017): which outlines a three-year plan to help grow tourism and the Hawkesbury's visitor economy.

- *The 2017 Metropolitan Water Plan for Sydney* (DoI, 2017b): which outlines a plan to optimise existing water supplies; details of water efficiency and conservation programs; actions to manage drought across the Sydney Metropolitan area.
- *WaterPlan 2050:* which is the long-term blueprint for managing the Central Coast's water resources.
- *Water Sharing Plan for the Central Coast Unregulated Water Sources* (NSW Government, 2009): which includes rules for protecting the environment, water extractions, managing licence holders' water accounts and water trading in the plan area.
- *Water Sharing Plan for the Kulnura Mangrove Mountain Groundwater Sources* (NSW Government, 2003): which manages groundwater extraction to protect and enhance ecological processes and the diversity of terrestrial groundwater dependent ecosystems across the Central Coast Water Management Area known as the Kulnura Mangrove Mountain Groundwater Sources.

3.5.5 Local Level Plans

As per the requirements of the *Local Government Act 1993*, all NSW local governments are required to prepare a series of strategic plans that conform to the structure of the state Integrated Planning and Reporting (IP&R) Framework. The structure of this framework is depicted in Figure 3-14, and a brief overview of the components is provided below. A summary of relevant planning documents is provided in Table 3-13.

The Community Strategic Plan is the overarching, visionary document that translates the community's key priorities and aspirations into long-term strategic goals that guide the future direction of the LGA. The Plan represents the highest level of strategic planning undertaken by a local council. As per NSW OLG, 2019, the Plan essentially addresses four key questions for the community:

- *Where are we now?*
- *Where do we want to be in ten years' time?*
- *How will we get there?*
- *How will we know when we have arrived?*

All other plans developed by councils in the study area (such as CMPs) must reflect and support implementation of the Community Strategic Plan. In fact, under the CM Act, the objectives and management actions developed as part of CMPs are required to be strategically aligned with the objectives and strategies outlined in the Community Strategic Plan. Linkages to the various Community Strategic Plans of the partner councils are provided in Appendix C. Other strategic planning activities may be undertaken by a council to support the achievement of outcomes in specific areas identified in the Community Strategic Plan (NSW OLG, 2019). These may include, for instance, a Cultural Plan, an Economic and Tourism Strategy, Emergency Risk Management Planning, Climate Change Planning, or even a Heritage Plan.

In March 2018, amendments to the *Environmental Planning and Assessment Act 1979* (the EP&A Act) introduced a new requirement for councils to prepare and make a Local Strategic Planning Statement (LSPS), which sets out the 20-year vision for land use in the local area, and how change will be managed into the future (NSW OLG, 2019). These plans provide a link between the state government's strategic plans and local council's local land use plans and guidelines. The LSPS forms part of a council's IP&R Framework, providing an important link with the Community Strategic Plan.

Other strategic plans will include a Local Environment Plan (LEP), which all NSW local governments are required to prepare under the direction of the state government. The purpose of LEPs is to regulate land use and development. They guide planning decisions for local governments and allow councils to regulate the ways in which all public land may be used and protected through zoning and development controls. A Development Control Plan (DCP) provides detailed planning and design guidelines to support the planning controls in each LEP.

The Delivery Program is a four (4) year program that translates the strategic objectives of the Community Strategic Plan into actions. It identifies all key activities a council has committed to undertake over its four-year

life cycle. The Resourcing Strategy supports the delivery program and outlines the resources required to implement it. It is therefore a critical link when translating strategic objectives into actions. The Resourcing Strategy generally consists of three inter-related elements: Long-Term Financial Planning, Asset Management Planning and Workforce Planning (NSW OLG, 2019).

The Operational Plan is generated over shorter, one-year planning timeframes and provides the detail of the Delivery Program, identifying the individual projects and activities that will be undertaken in a specific year to achieve the commitments of the program.

Reporting is a key element of the IP&R framework. Councils must prepare an Annual Report that provides information regarding progress and success in implementation of the Operational Plan and Delivery Program.

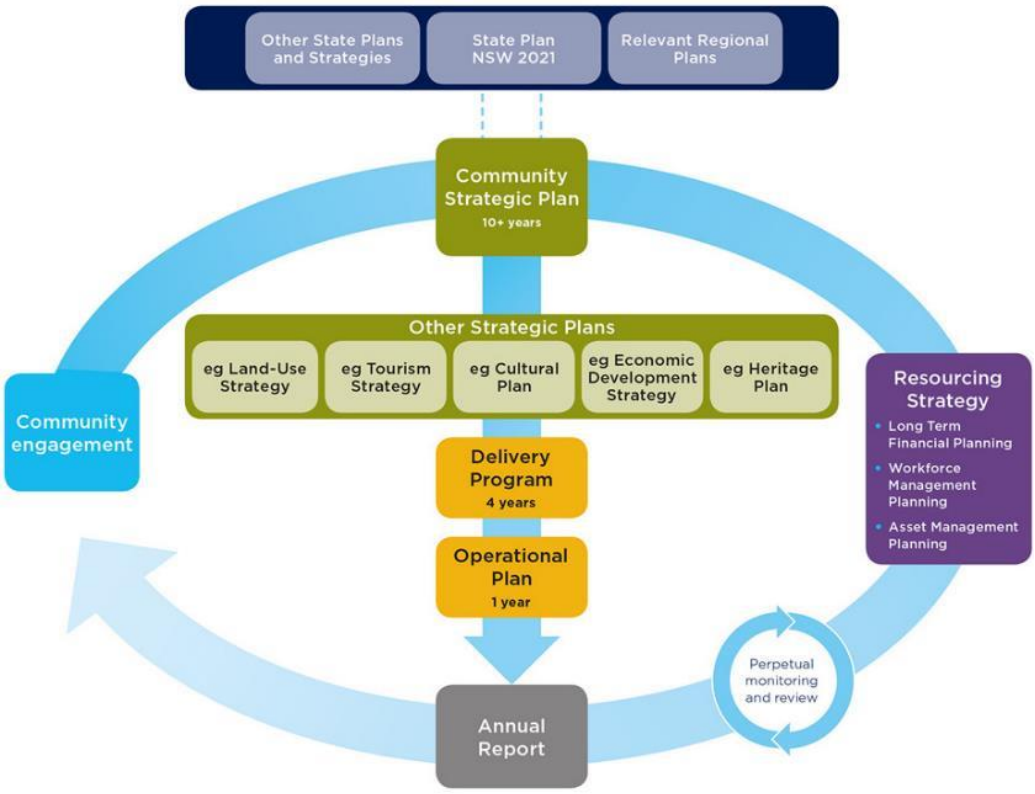


FIGURE 3-14 INTEGRATED PLANNING AND REPORTING FRAMEWORK (SOURCE: NSW OLG, 2019)

Local councils also develop and implement a range of other local level plans relevant to the study area. These plans vary from one LGA to the other, but generally include variations of the following to name just a few:

- Flood risk management plans for creeks and sub-catchments;
- Integrated water management plans and stormwater management plans;
- Heritage management plans;
- Climate change mitigation and adaptation plans;
- Biodiversity, vegetation and pest species management plans;
- Plans of Management crown reserves and community lands;
- Housing and land use strategies;
- Economic development and tourism strategies;

- Waste strategies;
- Bushfire Management strategies; and
- Master planning and public domain projects.

TABLE 3-13 LOCAL PLANNING DOCUMENTS FOR PARTNER COUNCILS

Instrument	Central Coast Council	Northern Beaches Council	Ku-ring-gai Council	Hornsby Shire Council	The Hills Shire Council	Hawkesbury City Council
Community Strategic Plan	▪ *One Central Coast:* Central Coast, Community Strategic Plan 2018-2028	▪ *Shape 2028*: Northern Beaches Community Strategic Plan 2018 - 2028	▪ Community Strategic Plan - Our Ku-ring-gai 2038	▪ *Your Vision | Your Future 2028*: Community Strategic Plan 2018 - 2028	▪ The Hills Future 2017-2021 Community Strategic Plan	▪ Hawkesbury Community Strategic Plan 2017-2036
Local Environment Plans	▪ Gosford LEP 2014 # ▪ Wyong LEP 2013 #	▪ Warringah LEP 2011 ▪ Pittwater LEP 2014 ▪ Manly LEP 2013	▪ Ku-ring-gai LEP 2015^	▪ Hornsby LEP 2013	▪ The Hills LEP 2019	▪ Hawkesbury LEP 2012
Development Control Plans	▪ Gosford DCP 2014 # ▪ Wyong DCP 2013 #	▪ Warringah DCP 2011 ▪ Warringah DCP 2000 ▪ Pittwater 21 DCP ▪ Manly DCP 2013	▪ Ku-ring-gai DCP 2016^	▪ Hornsby DCP 2013	▪ The Hills DCP 2012	▪ Hawkesbury DCP 2012
Resourcing Strategy	▪ Central Coast Council Resourcing Strategy 2018-2028	▪ Northern Beaches Council Resourcing Strategy 2018 – 2028	▪ Ku-ring-gai Council Resourcing Strategy 2019-2029	▪ Hornsby Shire Council Resourcing Strategy 2013	▪ The Hills Shire Council 2017-2021 Resourcing Strategy	▪ Hawkesbury City Council Resourcing Strategy 2017-2027
Delivery Program and Operational Plans	▪ Central Coast Council Delivery Program and Operational Plan 2019-20	▪ Northern Beaches Council Delivery Program 2019-2023 and Operational Plan 2019/20	▪ Ku-ring-gai Council Delivery Program 2018-2021 and Operational Plan 2019-2020	▪ Hornsby Shire Council Delivery Program 2019-21 and Operational Plan 2019/20	▪ The Hills Shire Council 2017-2021 Delivery Program and 2019-2020 Operational Plan	▪ Hawkesbury City Council Delivery Program 2017-2021 Operational Plan 2019-2020

Note that Central Coast Council is currently working to consolidate the existing LEP into one plan, the Central Coast Local Environmental Plan (CCLEP) Development Control Plan (CCDCP)

^ Note that the Ku-ring-gai Local Environmental Plan (Local Centres) 2012 and Ku-ring-gai Local Centres Development Control Plan 2017 are currently in the process of being amalgamated with the LEP and DCP listed in the table.

3.6 Economic Context

3.6.1 Aquaculture and Commercial Fishing

The Hawkesbury-Nepean River system supports a range of aquaculture and commercial fishing activities and is a significant contributor to the "blue economy" of the Central Coast and Greater Sydney regions. The river system has a long and rich history of supporting oyster farming and prawn estuary trawling. In addition to this, the wider Hawkesbury-Nepean catchment also supports a significant local agriculture industry which is both directly and indirectly affected by the water quality and the flows of the upper-catchment.

Interrogation of local council *CommunityID* data for each of the six (6) partner council LGAs provides an overview of the total economic value of these industries across the CMP study area. Results for the six (6) LGAs combined are provided in Table 3-14 and give an indication of the value of agricultural sector activity that is either directly, or indirectly, supported by the Hawkesbury-Nepean River system.

TABLE 3-14 ECONOMIC VALUE OF AGRICULTURE, FORESTRY AND FISHING

Sector	Economic Value Added $m /year
Agriculture	$502.5
Aquaculture	$1.6
Commercial Fishing	$3.5
Agriculture, Forestry and Fishing Support Services	$87.2
Total	***$594.7***

Commercial oyster farming has been undertaken across the Hawkesbury since the early 1900's (BMT WBM, 2008), and today the Lower Hawksbury River Estuary and the Brisbane Water Estuary remain a hub of oyster aquaculture. As per Table 3-15, NSW Aquaculture Production Reports (DPI, 2001) show that for the FY 2000/01, oyster farms in the Hawkesbury River and Brisbane Water generated a production value of nearly $10 million (adjusted for inflation to present day value) and accounted for nearly 20% of the state's total oyster production value. However, in 2004 the Hawkesbury River experienced a significant outbreak of QX disease, resulting in massive stock losses that affected production (Rubio et al, 2013). The region was again hit hard by an outbreak of Pacific Oyster Mortality Syndrome (POMS) in January 2013, where around 90% of the Hawkesbury's oysters were wiped out within 24 hours (Paul-Pont et al, 2014). The local industry has since been gradually recovering, and the Aquaculture Production Report 2018/2019 (DPI, 2020) showed that the value of oyster production across the system was around $1.8 million (around a fifth of its 2001/01 production value) and accounted for around 3% of the state's total oyster production value. It should be noted that a new commercial venture, Broken Bay Pearls, has commenced in both Brisbane Waters and Hawkesbury growing native pearl oysters.

TABLE 3-15 HAWKESBURY RIVER AQUACULTURE STATISTICS

Estuary	Value of Oyster Production 2000/01[#]	Value of Oyster Production 2018/19
Brisbane Water	$4.9m	$1.2m
Hawkesbury River	$4.8m	$650k
Total	***$9.7m***	***$1.8m***
% of Total NSW Production Value	***20%***	***3%***

[#] *values have been adjusted for inflation to 2018/19 dollar terms for comparative purposes*

FIGURE 3-15 HAWKESBURY RIVER AQUACULTURE (SOURCE: ABC NEWS)

Commercial fishing in the Hawkesbury River has the sixth largest estuarine production area in NSW, and is the state's fourth largest fishery (BMT WBM, 2008). The largest sector of commercial fishing in the Hawkesbury estuary is the prawn trawl (EPT) fishery. This involves the harvesting of school prawns, squid and fish (Kimmerikong, 2005). The Hawkesbury River EPT Fishery operates in waters from the ocean entrance, upstream to the vehicular ferry at Lower Portland. The fishery is estimated to generate an annual catch with a monetary value of around $3.5 million (DoI, 2017). Commercial fishing is banned in Brisbane Water but permitted in Broken Bay and offshore (TfNSW, 2015).

3.6.2 Ecosystem Services

As part of this Scoping Study, a preliminary economic valuation has been undertaken of the ecosystem services across the Hawkesbury River Estuary. This assessment has been undertaken using the method of Costanza et al (2014) which provides approximate unit values for ecosystem services and land usages. It should be noted that the true value of the ecosystem services in the study area is difficult to capture – and this analysis is not intended to be an in depth economic assessment, but rather is intended as a coarse, *preliminary estimation* in order to gain a broad understanding of the economic value of the ecosystem services across the Hawkesbury River Estuary, and to provide high-level guidance for the Business Case (see Section 11). The Costanza (2014) method assigns USD unit pricings for biomes - based on overall estimates of economic value and contribution. For example, tidal marsh and mangroves provide value in the form of storm protection, erosion control, carbon storage and waste treatment. Results of the relative economic contribution are provided in the table below. The table shows that the ecosystem services of the estuarine reach of the Hawkesbury River (including Pittwater Estuary and Brisbane Water Estuary) are of the order of around **$1 billion per year.**

TABLE 3-16 APPROXIMATE ECONOMIC VALUATION OF HAWKESBURY RIVER ESTUARY ECOSYSTEM SERVICES

Biome	Approx. Area (ha)	Costanza (2014) USD Unit Value (USD/ha/yr)	Approx. AUD Unit Value (AUD/ha/yr)	Approx. Total Ecosystem Services Value (AUD/yr)
Mangrove	1209	$190k	$260k	$310m
Saltmarsh	403	$190k	$260k	$100m
Seagrass	835	$29k	$40k	$30m
Estuary	14,450	$29k	$40k	$580m
			Total	**~$1.0bn**

3.6.3 Tourism and Recreation

The Brisbane Water, Pittwater and Hawkesbury River estuaries provide significant economic value to the Greater Sydney and Central Coast regions in the form of tourism. The close proximity to the high-density population bases of Sydney and the Central Coast provide significant opportunities for day trip tourism and domestic and international overnight visitor stays.

Domestic day trip tourism is highly focused on the coastal zone – and the environmental, recreational and aesthetic aspects of the Hawkesbury act as a strong tourist draw card for activities such as watercraft activities (such as kayaking – see Figure 3-16), fishing, nature observation, recreational and charter boating, and bushwalking through the expanse of national parks of the study area.

FIGURE 3-16 KAYAKING THE HAWKESBURY (SOURCE: DESTINATION NSW)

The system provides direct economic value through industries that include (but are not limited to) charter boating and day cruises, fishing and whale watching. The majority of these businesses operate out of Brisbane Water, Pittwater and the Lower Hawkesbury River at Brooklyn.

Rolyat (2013) estimated that across the activities of sightseeing, camping, swimming, recreational fishing and boating, the Hawkesbury River Estuary receives over 1.3 million annual day visits, with a combined economic value of over **$45 million dollars per annum**.

Visitation and economic value of tourism across the six (6) partner councils has been interrogated via the *CommunityID* data and is presented in Table 3-17 below. Whilst it is acknowledged that it is not possible to directly link these visitation and economic figures directly with the river system (particularly for large LGAs such as the Central Coast and Northern Beaches, where other social and geographic factors may represent significant contributors to tourism activity), these numbers can provide context needed to assess the potential touristic use base and high level recreational use pressed on the system.

TABLE 3-17 PARTNER COUNCIL TOURISM DATA (SOURCE: COMMUNITY ID, 2019)

Tourism Metric (per annum)	Hawkesbury River Estuary Partner Council LGA's	Total for Greater Sydney Region*
International Visitor Nights (millions)	6.0	83.1
Domestic Visitor Nights (millions)	6.8	32.5
Domestic Daytrips (millions)	7.1	25.3
Economic Value Added	$3.7b	$40.5b

* *Destination NSW Sydney Visitor Profile*

Roylat (2013) also identified that there is a strong industry in the Hawkesbury River estuary employed maintaining and servicing vessels. The total replacement value for all moored and berthed vessels on the Hawkesbury River estuary is estimated at $1.5 billion, of which around $1 billion worth are located within Pittwater. According to Roylat (2013), annual operating and maintenance costs for a berthed vessel can be reasonably estimated at 10% of its replacement cost, with maintenance of around 7.5% for moored vessels as

annual mooring fees are considerably cheaper than berthing charges. Therefore, the total annual operating and maintenance costs for all vessels either moored or berthed in the estuary east of Wisemans Ferry are estimated at **$135 million**.

Additionally, Roylat (2013) estimated that the estimated replacement value of fixed foreshore assets in the estuary is around **$270 million**. This includes marinas, public wharves, car and vehicle/ boat trailer parking spots, and boat washing facilities etc.

Whilst the overall economic value of a functioning and healthy estuary system is difficult to quantify, it is nonetheless reasonable to state that there are substantial economic benefits associated with the condition and health of the estuary environment.

3.7 Social and Cultural Context

3.7.1 Indigenous Heritage

Indigenous cultural heritage consists of places and items that are of significance to indigenous people because of their traditions, observances, lore, customs, beliefs and history. It provides evidence of the lives and existence of indigenous people before European settlement through to the present. Indigenous cultural heritage is dynamic and may comprise physical (tangible) or non-physical (intangible) elements (LCC, 2019). It includes things made and used in traditional societies, such as stone tools, art sites and ceremonial or burial grounds. It also includes more contemporary and/or historical elements such as old mission buildings, massacre sites and cemeteries. Tangible heritage is situated in a broader cultural landscape and needs to be considered in that context and in a holistic manner.

Indigenous cultural heritage also relates to the connection and sense of belonging that people have with the landscape and each other. It recognises that indigenous people understand cultural heritage and cultural practices as being part of both the past and the present and that cultural heritage is kept alive and strong by being part of everyday life.

Cultural heritage is not confined to sites; it also includes peoples' memories, storylines, ceremonies, language and 'ways of doing things' that continue to enrich local knowledge about the cultural landscape. It involves teaching and educating younger generations. It is also about learning and looking after cultural traditions and places, and passing on knowledge. It is enduring but also changing. It is ancient but also new.

Indigenous cultural knowledge provides crucial links between the past and present and therefore represents an essential part of the identities of Indigenous people and all Australians (OEH, 2015).

The Hawkesbury Region has a rich and continuing Indigenous heritage, with cultural history extending more than 40,000 years. This long history of settlement has naturally resulted in both tangible and intangible indigenous cultural heritage across the wider Hawkesbury-Nepean Catchment. As the study area and its contributing catchment is relatively large, there are a number of local indigenous groups that have historically inhabited the region. The relative indigenous population across the six partner councils is presented in Table 3-18 below, along with the average across the Greater Sydney region and the state.

TABLE 3-18 ABORIGINAL AND TORRES STRAIT ISLANDER POPULATION ACROSS THE STUDY AREA

LGA/ Region→	Northern Beaches	Ku-ring-gai	Hornsby	Hills	Hawkesbury	Central Coast	Greater Sydney	NSW
LGA Pop. %	0.6%	0.2%	0.5%	0.5%	3.7%	3.8%	1.5%	2.9%

Traditionally, the Greater Sydney region is home to several clans of the Darug people (also spelt Dharug, Daruk or Dharik). Darug are thought to have inhabited the area between Port Jackson and Botany Bay in the

east, the Georges River to the south-west, and the Hawkesbury River in the north-west, (Cumberland, 2019). Across the Upper Hawkesbury River Estuary, the Richmond-Windsor region was inhabited by the people of the Burreberongal, Cattai and Kurrajong Clans which were situated on the south, east and north of the river respectively (Barani, 2019).

The Lower Hawkesbury area was originally inhabited by the Ku-ring-gai (also spelt Guringai) people, who occupy the area across Sydney stretching from Broken Bay (in the north) to Port Jackson (in the south) and the Lane Cove River (in the west) (NPWS, 2002). Two groups of the Ku-ring-gai people occupied the area which is now Ku-ring-gai National Park: the Garigal people and the Darramuragal people (NPWS, 2002).

North of the Hawkesbury in the Central Coast Region was home to the Ku-ring-gai and the Darkinjung people. The traditional boundaries of Darkinjung land extend from the Hawkesbury River in the south, Lake Macquarie in the north, the McDonald River and Wollombi up to Mt Yengo in the west and the Pacific Ocean in the East (Darkinjung LALC, 2019).

The Hawkesbury River was known as Deerubbin by the Darug people (BMT WBM, 2014a) and is believed to have been an important source of water, food (fish, eels, mussels, oysters), water birds and as a method of transportation (BMT WBM, 2014a). There are thousands of indigenous heritage sites located across the study area (and likely to be many more yet unidentified sites). These include middens, stone arrangements, burials, axe-grinding grooves, cave art sites and rock engravings. Review of existing studies shows the following identified sites across the study area:

- 350 sites Ku-ring-gai Chase NP (NPWS, 2002);
- 1,076 across the Lower Hawkesbury Estuary (BMT WBM, 2008); and
- 274 sites across Brisbane Water Estuary (CLT, 2009).

Analysis of the NSW Office of Environment and Heritage's Aboriginal Heritage Information System (AHIMS) database shows that the greatest number of recorded sites is in the Hawkesbury Shelf Marine Bioregion with 6565 recorded sites in and within 500m of the NSW Marine Estate. This is equal to the combined total of sites in all other marine bioregions (Feary, 2015)

An interrogation of the National Native Title Register (NNTR) found no existing or pending federal native title claims across the LGAs of the six partner councils. The extent of claims made under the NSW claims via the *NSW Aboriginal Land Rights Act 1983* across the study area are not known at this time.

3.7.2 Population and Demographics

The Greater Sydney and Central Coast regions are home to a diverse array of peoples, with up to 37% of the population of Greater Sydney born outside Australia (compared to the national average of 23%, - Community ID, 2019), with over 90 languages spoken across the region and around 36% of the population speaking a language other than English at home (Community ID, 2019). The demographics of the Central Coast do differ from that of Greater Sydney, where around 15% of the population were born overseas and around 6% of people speak a language other than English at home. Additional demographic analysis is provided in the stakeholder analysis given in Section 4.4.

According to GSC (2018), Greater Sydney is one of the top ten fastest-growing regions in the Western world – with the NSW Department of Planning projecting that the population of the region (of around 4.7 million people) will increase by around 1.7 million by 2036, and 3.2 million by 2056.

Population projection data obtained from the NSW Department of Planning at an LGA level and concatenated into a number of regional groups presented in Table 3-19. The results show the projected increase in population predicted for Greater Sydney, the partner council LGAs and the LGAs comprising the wider Hawkesbury-Nepean Catchment (listed in Table 3-8). This provides a snapshot of population growth and

urbanisation challenges that must be considered as part of the CMP. **This shows that the population of the estuary and catchment LGA's is expected to increase by around 1 million people by 2036.**

TABLE 3-19 POPULATION GROWTH ACROSS THE STUDY AREA 2016-2036

Region	2016	2036	Annual Increase
Hawkesbury Estuary Partner Council LGAs	1,100,000	1,400,000	1.2%
Hawkesbury-Nepean Catchment Councils LGAs	1,800,000	2,500,000	1.6%
Total Across Partner and Catchment LGAs	***2,900,000***	***3,900,000***	***1.5%***

Further granularity depicting population projections across the six (6) partner councils is provided in Table 3-20. The results show that the majority of these LGAs will experience below average growth over this period, however The Hills Council population is projected to increase at a substantially faster rate during this period, and this is associated with a number of proposed large-scale master planning estate developments at Box Hill and Kellyville that are part of the proposed The North West Growth Area (see Section 3.2.2).

TABLE 3-20 POPULATION GROWTH ACROSS PARTNER COUNCILS 2016-2036

LGA	2016 Population	2036 Population	Annual Increase
Central Coast Council	339,550	415,050	1.0%
Hawkesbury City Council	67,800	85,050	1.1%
The Hills Shire Council	165,550	290,900	2.9%
Hornsby Shire Council	149,650	178,100	0.9%
Ku-ring-gai Council	123,500	154,500	1.1%
Northern Beaches Council	263,700	297,950	0.6%

It should be noted that a number of high growth regions are projected for the wider Hawkesbury-Nepean Catchment – particularly the proposed Western Parkland City outlined in *A Metropolis of Three Cities – the Greater Sydney Region Plan* (GSC, 2018). The Plan outlines a significant growth corridor in between Campbelltown and Penrith (see Figure 3-13) that includes the proposed Badgerys Creek Aerotropolis. Table 3-21 shows the LGAs across this corridor that are projected to experience above average population growth over the 2016-2036 planning period. The Camden LGA will experience a significant increase in growth of over 5% p.a. This urbanisation and population growth across the Wider Hawkesbury-Nepean Catchment is likely to result in significant urban stormwater and industrial discharge impacts on the river system as a whole.

TABLE 3-21 PROJECTED HIGH GROWTH POPULATION AREAS ACROSS WESTERN SYDNEY 2016-2036

LGA	2016 Population	2036 Population	Annual Increase
Blacktown City Council	349,050	521,450	2.0%
Camden Council	80,900	224,550	5.2%
Campbelltown City Council	164,400	233,150	1.8%
Liverpool City Council	214,100	331,000	2.2%
Wollondilly Shire Council	49,350	72,600	1.9%

3.7.3 Community Values & Uses

The Hawkesbury River Estuary is a unique and beautiful estuary of national significance and value (BMT WBM, 2008). It provides visual amenity and a vast array of recreational opportunities to both the local community and its visitors.

Recreational boating is a popular pastime in the Hawkesbury River, Pittwater and Brisbane Water regional waterways. Recreational users undertake a wide variety of boating activities across the study area including fishing, water skiers, wake vessels, rowers, kayakers, sailing, and yachting (TfNSW, 2015). A relatively unique characteristic of boating across these waterways is the large number of recreational vessels used for commuting purposes by people living on islands (such as Scotland Island in Pittwater, and Dangar Island in the Lower Hawkesbury) and in other isolated locations along the foreshore.

There are over 100,000 boat licence holders in the Hawkesbury River, Pittwater and Brisbane Water region. This represents approximately 19% of all boating licences in NSW (TfNSW, 2015). The region also has the highest proportion (approximately 25%) of vessels over six metres in the State. Additionally, there are approximately 41,000 registered recreational vessels in the Hawkesbury River, Pittwater and Brisbane Water region (around 17% of all registered recreational vessels in NSW). There are approximately 40 public boat ramps across the study area (21 in Brisbane Water, 16 in the Hawkesbury River and three in Pittwater), and over 100 public access points including wharves, jetties, pontoons and landings (TfNSW, 2015).

The Hawkesbury River is an extremely popular, but diverse waterway in terms of its recreational usage. The river is utilised extensively for a range of different activities. Across the upper reaches of the Hawkesbury between Windsor and Wisemans Ferry, major recreational uses include water skiing and wakeboarding. Non-powered watercraft activities such as kayaking and canoeing are popular in the more natural areas such as the Colo River and Webb's Creek (BMT WBM, 2013c; TfNSW, 2015). The Hawkesbury also hosts a number of major local sporting events (sailing, rowing, and water skiing) throughout the year, including the *Bridge 2 Bridge Water Ski Classic* which attracts competitors nationally and globally (see Figure 3-17) and *The Hawkesbury Canoe Classic* . Throughout the Lower Hawkesbury recreational fishing is extremely popular - with NSW Fisheries estimating there to be 150,000 recreational fishing outings in the Hawkesbury River per year (BMT WBM, 2008). In addition to boat-based fishing, there are a variety of locations from which fishing is permitted from the shore, including Parsley Bay, Cowan Creek and McKell Park (WRL, 2003).

FIGURE 3-17 BRIDGE 2 BRIDGE WATER SKI CLASSIC

With its highly developed foreshore and concentrated population base, the Brisbane Water Estuary is a popular waterway with recreational users including power boating, sailing, water skiing, fishing, paddling, kayaking and rowing (TfNSW, 2015). Personal Watercraft (PWCs) are popular throughout most of the estuary. Fishing is popular in a number of areas such as between Paddy's Channel and Fagan's Bay. In the summer months, the use of Brisbane Water increases for all recreational activities, which at times generates significant user group conflict.

Pittwater is one of the busiest waterways in the State owing to its close proximity to a highly urbanised population dense region of northern Sydney. Figure 3-18 shows the intensity of the waterway use across the estuary. The estuary accommodates a significant number of larger vessels which are housed on private swings moorings and across the eight marinas/boating clubs and 26 wharves/boat sheds that punctuate the

estuary (L&T, 2003) - including the Royal Prince Alfred Yacht Club and the Royal Motor Yacht Club .This intense recreational usage generates user conflict amongst the various use types such as sailing, kayaking, fishing, sailboarding, kite-surfing, water skiing and, dragon boating (TfNSW, 2015; BMT WBM, 2008). Fifteen beaches and coves are spread throughout the estuary, which attract recreational use from visitors and locals predominantly at the weekends and summer periods (L&T, 2003).

Broken Bay contains a number of high value beaches, including Ocean Beach, Umina Beach, Pearl Beach and Patonga Beach - and these beaches represent a significant social resource for the local community and visitors alike. Ocean and Umina Beach in particular have a high recreational value for the surfing community. Popular beach activities also include water sports, swimming, walking and nature appreciation.

FIGURE 3-18 RECREATIONAL BOATING IN PITTWATER (LEFT) AND SURFING AT OCEAN BEACH (RIGHT)

It is also important to appreciate the significant non-use value (or existence value) of the river system and its surrounding foreshore. This non-use value is often reflected as a sense of wellbeing from the knowledge that the estuary system and its biodiversity exist, even if it is never utilised or experienced first-hand (Hageman, 1985). Additional bequest value also exists in the form of the value that the current generation places value on ensuring the availability of biodiversity and ecosystem functioning to future generations.

Key social and community values associated with the study area, based on a literature review of existing stakeholder engagement activities, is provided in Section 8.

4 STAKEHOLDER ENGAGEMENT

4.1 CMP Engagement Requirements

The CM Act requires local councils to consult with the community and stakeholders before adopting a CMP. Section 16 of the CM Act requires that:

> *(1) Before adopting a coastal management program, a local council must consult on the draft program with:*
>
> > *(a) the community, and*
> >
> > *(b) if the local council's local government area contains: (i) land within the coastal vulnerability area, any local council whose local government area contains land within the same coastal sediment compartment, and (ii) an estuary that is within 2 or more local government areas, the other local councils, and*
> >
> > *(c) other public authorities if the coastal management program: (i) proposes actions or activities to be carried out by that public authority, or (ii) proposes specific emergency actions or activities to be carried out by a public authority under the coastal zone emergency action subplan, or (iii) relates to, affects or impacts on any land or assets owned or managed by that public authority.*
>
> *(2) Consultation under this section is to be undertaken in accordance with the relevant provisions of the coastal management manual.*
>
> *(3) A failure to comply with this section does not invalidate a coastal management program.*
>
> *(4) The regulations may amend Schedule 1.*

Part A of the coastal management manual includes statutory provisions and mandatory requirements relating to community and stakeholder engagement. These provisions and requirements include:

> *A draft CMP must be exhibited for public inspection at the main offices of the councils of all local government areas within the area to which the CMP applies, during the ordinary hours of those offices, for a period of not less than 28 calendar days before it is adopted. This mandatory requirement does not prevent community consultation, or other consultation, in other ways.*

4.2 CMP Engagement Guidelines

The NSW Government has issued guidelines for community and stakeholder engagement related to the CMP process titled '*Guidelines for community and stakeholder engagement in coastal management*' (OEH, 2018b). These guidelines provide engagement approaches to help meet the requirements in Section 4.1 and recommended approaches to enable community and stakeholder feedback to enhance the development of the CMP.

The guidelines recommend the use of the International Association for Public Participation (IAP2) spectrum, which is a widely accepted model to design engagement strategies and plans. As shown in Figure 4-1, the spectrum identifies five levels of engagement, the goal of each level and the community's role in decision-making and implementation.

Increasing impact on the decision →					
Public participation goal (what are we trying to achieve)	**Inform**	**Consult**	**Involve**	**Collaborate**	**Empower**
	To provide the public with balanced and objective information to help them understand the problem, alternatives and/or solutions	To obtain public feedback on alternatives and/or decisions	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered	To partner with the public in each aspect of the decision including the development of alternatives and identification of the preferred solution	To place the final decision-making in the hands of the public
Promise to the public	We will keep you informed	We will keep you informed, listen to and acknowledge concerns and provide feedback on how public input influenced the decision	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision	We will work with you to formulate solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible	We will implement what you decide

FIGURE 4-1 IAP2 SPECTRUM

The guidelines for Stage 1 of the CMP process recommend the following engagement activities:

1. Identify the various stakeholders that need to be engaged in the CMP process;
2. Conduct a community profile across the study area;
3. Develop a coastal community and stakeholder engagement strategy for all stages in the CMP process; and
4. Establish a coastal management advisory group. This group was developed through the six partner councils and broader stakeholders (see Section 1.5)

4.3 Stakeholder Analysis

As listed in the guidelines there are three broad categories of stakeholders:

1. The local community;
2. Local Government (Councils); and
3. Other stakeholders (such as state government agencies).

4.3.1 Community stakeholders

In the guidelines, ‘community’ refers to any individual or group of individuals who have something in common. They are members of the public who may be residents in the local government area or a local interest group.

Analysis of previous studies and engagement plans (Section 4.5) related to the study area, identify the following individuals and groups under 'community':

- Residents (ratepayers and non-ratepayers)
- Tourists
- Non-resident workers
- Environment groups
- Progress associations and other community groups
- Business organisations including chambers of commerce
- Community recreational groups including Surf Life Saving Clubs
- Schools and other education institutions
- Retirement homes and other aged facilities
- Commercial boating and tourism operators
- Commercial fishers and aquaculture farmers e.g. oyster farmers

It should be noted that an individual can be in one or more of these groups.

An analysis of the key community groups in the study area was conducted using the Community Directories on the website of each partner local council. Table 4-1 provides a summary of this analysis.

TABLE 4-1 KEY COMMUNITY GROUPS IN THE STUDY AREA

Category	Key community groups
Environment	▪ Australian Conservation Foundation – Central Coast ▪ Community Environment Network (based at Ourimbah) ▪ Bushcare (Central Coast, Hawkesbury, Hornsby, Ku-ring-gai, Northern Beaches, The Hills) ▪ Ettymalong Creek Landcare (Umina) ▪ Pearl Beach Dune Care Group ▪ National Parks Association (Central Coast) ▪ Dharug and Lower Hawkesbury Historical Society ▪ Brisbane Water Historical Society ▪ Australian Plants Society North Shore Group ▪ Wahroonga Waterways Landcare ▪ Ku-ring-gai Wildflower Garden ▪ Dural and District Historical Society ▪ Ku-ring-gai Historical Society ▪ Northern Beaches Council Friends of the Bush ▪ The Hills Shire Bushland Conservation Committee ▪ Pittwater Natural Heritage Association ▪ Floating Landcare ▪ Coasters Retreat Historical Society ▪ Church Point Reserve Association ▪ Hawkesbury Historical Society ▪ Hawkesbury Environment Network

Category	Key community groups
	▪ Dangar Island Historical Society
Fishing/angling	▪ Anglers Action Group (Sydney Northside) ▪ Newport Arms Fishing Club ▪ Warringah Anglers Club ▪ Ku-ring-gai Hornsby Angling and Casting Club ▪ Brooklyn Fishing Club ▪ Gosford RSL Fishing Club ▪ Central Coast Game Fishing Club ▪ NSW Recreational Fishing Alliance
Commercial Fishing and Aquaculture	▪ Hawkesbury River Commercial Fishers Association ▪ Broken Bay Oysters Association ▪ Broken Bay Pearls ▪ Brisbane Waters Oysters
Boating/sailing	▪ Hawkesbury River Sailing Club ▪ Hawkesbury River Yacht Club ▪ Gosford Sailing Club ▪ Saratoga Sailing Club ▪ Hawkesbury River Dragon Boat Club ▪ Pittwater Pinks Dragon Boat Team ▪ Bayview Yacht Racing Association ▪ Royal Motor Yacht Club – Broken Bay, NSW ▪ Royal Prince Alfred Yacht Club (Newport) ▪ Upper Hawkesbury Power Boat Club (Windsor) ▪ Hornsby Ku-ring-gai Sailing Club ▪ Brisbane Waters Outdoor Club ▪ Central Coast Dragon Boat Club ▪ Deepwater Dragon Boat Club
Surf Life Saving Clubs	▪ Ocean Beach SLSC ▪ Umina SLSC
Business & Industry	▪ NSW Farmers ▪ Stormwater NSW ▪ Gosford/Erina & Coastal Chamber of Commerce and Industry ▪ Peninsula Chamber of Commerce ▪ Ku-ring-gai Chamber of Commerce ▪ Sydney Hills Business Chamber ▪ Central Coast Plateau Chamber of Commerce ▪ Hornsby Chamber of Commerce ▪ Pittwater Business ▪ Newport Chamber of Commerce ▪ Dural Round Corner Chamber of Commerce ▪ Windsor Business Group ▪ Brooklyn RSL

Category	Key community groups
	▪ Dural and Round Corner Chamber of Commerce Inc ▪ Hawkesbury Chamber of Commerce ▪ Sydney Hills Business Chamber ▪ Avalon Palm Beach Chamber of Commerce
Resident/ progress association	▪ Koolewong & Point Clare/Tascott Progress Association ▪ Davistown Progress Association ▪ Empire Bay Progress Association ▪ Pearl Beach Progress Association ▪ Patonga Beach Progress Association ▪ Mooney-Cheero Progress Association ▪ Spencer Community Progress Group ▪ Westleigh Progress Association ▪ Dural District Progress Association ▪ Green Point Resident's Association ▪ St Hubert's Island Resident's Association ▪ Pennant Hills District Civic Trust ▪ North Turramurra Action Group ▪ Duffys Forest Residents Association ▪ Terrey Hills Progress Association ▪ Glenorie Progress Association ▪ Hillside Progress Association ▪ Annangrove Progress Association ▪ Box Hill-Nelson Progress Association ▪ Bayview-Church Point Resident's Association ▪ Scotland Island Resident's Association ▪ West Pittwater Community Association ▪ Cottage Point Community Association ▪ Wisemans Ferry Community Centre ▪ Berowra Waters Progress Association ▪ Berowra & District Community Association ▪ Brooklyn Community Association ▪ Bar Point Community Association ▪ Milsons Passage Progress Association ▪ Lower Hawkesbury River Residents Association ▪ Mooney-Cheero Progress Association ▪ Peninsula Waterways Committee ▪ Umina Community Group ▪ Brisbane Water Historical Society ▪ Brisbane Water Area History Tours

Note- Bushcare/Landcare groups on the Central Coast fall within either the NPWS Landcare banner or the Central Coast Council Landcare banner. Therefore, it would be best to engage with the coordinators of these programs to ensure proper coverage.

There also numerous other community groups in the study area related to specific activities including Sea Scouts, Scouts, Marine Rescue Groups, youth groups (e.g. Y4Y – council facilitated youth group), Rotary, Lions, Probus and Apex clubs. Pre-schools, schools, universities (e.g. Ourimbah Campus – University of Newcastle, Hawkesbury Campus- University of Western Sydney) and TAFE colleges should also be considered in Stage 2-5 CMP engagement.

The guidelines recognise that the following groups can be highly vulnerable to coastal risks (e.g. floods, sea level rise) and thus may require further attention:

- people with disabilities;
- people with culturally, ethnically or linguistically diverse backgrounds;
- Aboriginal and Torres Strait Islanders;
- young people, elderly people;
- single parents; and
- people in remote locations.

Culturally appropriate engagement with traditional indigenous owners and the Local Aboriginal Land Councils (LALC) is an important part of the preparation of a CMP. It is valuable to understanding the cultural significance of the coastal landscape and the influence that coastal processes, hazards and environmental change may have on the values of physical and non-physical elements of cultural heritage. There are three LALCs across the estuarine reach of the study area:

- Darkinjung LALC
- Deerubbin LALC
- Metropolitan LALC

Each LALC will be engaged throughout the CMP planning process. However, it is recognised that these representative bodies may be limited in the extent they represent the interests of aboriginal people. The hope for Aboriginal people is that consultation during the development of a CMP will lead, to not only a report that recognises and responds to Aboriginal interests but also to opportunities for a much-enhanced involvement in management of the Hawkesbury-Nepean River system. Guidance for engagement with indigenous people is provided by Feary (2015).

An analysis of community values towards the Hawkesbury coast and estuary was conducted from previous studies including CZMPs. A summary of the findings from this analysis is provided in Sections 3.7.3and 8.2.

4.3.2 Council stakeholders

Internal (council) engagement forms an important part of stakeholder engagement for the CMP process. Council stakeholders include:

- mayor and councillors
- senior leadership team and relevant advisory committees
- council staff – from land use planning, natural resource management, asset, communications and engagement, roads & drainage, water & sewer, open space & recreation etc

4.3.3 Other stakeholders

Other stakeholders include state government agencies and NGOs. An analysis of these organisations is provided in Section 3.3.

4.4 Community Profile

The stakeholder engagement guidelines for the CMP process recommend that a community profile be developed that identifies some characteristics of the study area including:

- Community age structure;
- Cultural and language background;
- Residency e.g. permanent, renter;
- Types of residence e.g. separate house, apartment, villa;
- Language used;
- Indigenous population (Aboriginal and Torres Strait Islanders);
- Employment levels;
- Education levels; and
- Income.

An analysis of these factors (Table 4-2) was conducted for the six LGAs using the 2016 Census data (ABS, 2016). This data can assist in determining engagement strategies and also in the Stage 3 evaluation component. An analysis of current and future population is carried out in Section 3.7.

TABLE 4-2 COMMUNITY PROFILE ACROSS THE LGAS

Indicator	Central Coast	Hornsby	Ku-ring-gai	Northern Beaches	The Hills	Hawkesbury City
Median age (years)	42	40	41	40	38	38
0-14 years (%)	18.5	19.5	20.2	19.7	21.3	19.9
65 and over (%)	20.9	16.2	18.1	16.8	13.5	14.4
Children per family	1.8	1.8	1.9	1.8	1.9	1.9
Australia birth (%)	78.8	59.5	57.3	65.8	61.7	67.9
Rented (%)	26.8	21.2	17.5	25.9	17.1	24.3
Separate house (%)	78.5	73.4	73.5	57.7	82.4	85.9
% English at home	88.4	65.3	68.7	79.8	65.3	88.3
Indigenous (%)	3.8	0.5	0.2	0.6	0.5	3.7
Unemployed (%)	6.7	4.8	4.7	3.5	4.6	4.3
% Uni degree	14.0	38.4	47.9	32.3	33.5	13.1
Income/person ($)	600	793	942	916	827	728

As considerable proportions of each LGA are not in the CMP study area, this community profile is limited spatially. For a more granular investigation of specific communities in the study area a Social Atlas can be used. This will be particularly useful for Stage 2 where community vulnerability is assessed and Stage 3 where mitigation options are identified.

For example, the demographic characteristics of Davistown (Central Coast Council) can be accessed via the Social Atlas for the Central Coast LGA - https://atlas.id.com.au/central-coast-nsw. A sample output (population density) for part of Davistown is shown in Figure 4-2.

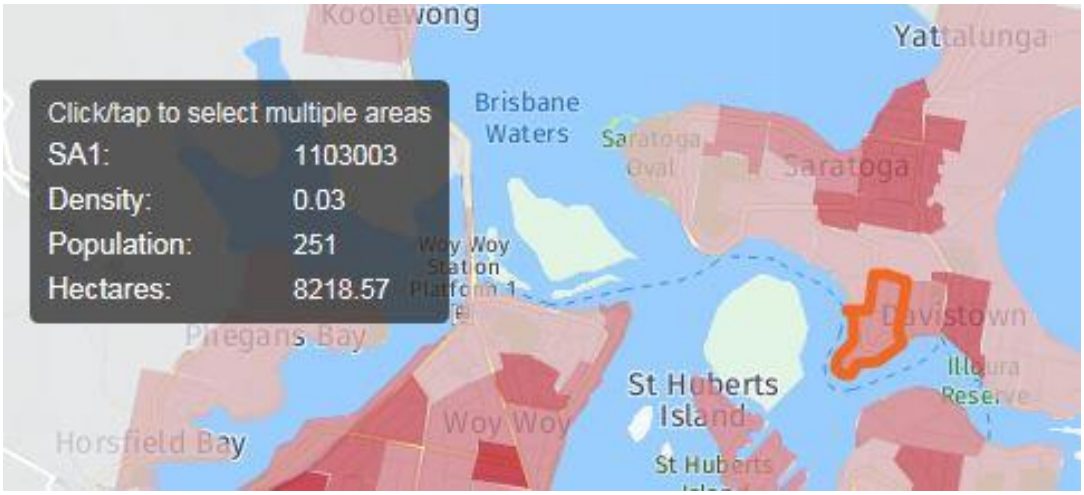


FIGURE 4-2 SAMPLE OUTPUT USING SOCIAL ATLAS

4.5 Previous Study Area Engagement and Existing Strategies

4.5.1 Stakeholder and Community Engagement Undertaken for Previous Studies and Plans

According to the engagement guidelines, 'plans, such as an existing coastal zone management plan or flood risk management plan or community development plan, may document issues and priorities that have previously been identified by stakeholders and the community'. For this study, five (5) CZMPs and EMPs were analysed to help understand engagement processes used and the views of local communities towards the study area values, uses and threats. The plans and accompanying studies analysed were:

- Upper Hawkesbury River Estuary Coastal Zone Management Plan (BMT WBM, 2014a);
- Lower Hawkesbury Estuary Management Plan (BMT WBM, 2008);
- Coastal Zone Management Plan for Brisbane Water Estuary (Cardno, 2012);
- Pittwater Estuary Management Plan (BMT WBM, 2010); and
- Gosford Beaches Coastal Zone Management Plan (WorleyParsons, 2017).

Upper Hawkesbury River Estuary Coastal Zone Management Plan (2014)

Several rounds of consultation were used to develop the Plan, which was undertaken with a broad range of community and other stakeholder representatives. The main engagement methods used were:

- Community drop in information booth;
- Open community meeting;
- Website including online surveys;
- Targeted stakeholder workshop including participants from relevant government agencies and industry; and
- Meeting and telephone-based discussions with representatives of the local aboriginal community.

The outcomes of these engagement activities are summarised in the Upper Hawkesbury River Estuary Community Consultation Report (BMT WBM, 2013c). A draft version of the CZMP was placed on public exhibition.

Lower Hawkesbury Estuary Management Plan (2008)

Three stakeholder workshops were used to develop this plan, as described in BMT WBM (2008):

- Workshop 1: Identify stakeholders' values (assets) and issues related to the estuary. Identify overall goals, vision and objectives for the estuary
- Workshop 2: Assess estuarine risks (related to defined issues) for their consequences on the assets and the associated likelihood of these impacts
- Workshop 3: Define strategies and their associated actions to treat priority risks, determine target states of risk reduction the actions are to achieve.

The LHEMP Committee provided advice throughout the planning process.

Coastal Zone Management Plan for Brisbane Water Estuary (2012)

A range of consultation activities were undertaken as part of the CZMP and the preceding Brisbane Water Estuary Management Study (Cardno, 2010). The approach adopted for the program of consultation was to (as per Cardno, 2012):

- Obtain feedback from key stakeholders and the community on values, uses, key issues and potential management options;
- Seek advice and input from the relevant agency stakeholders to assist in implementation of the Plan;
- Improve the awareness and understanding of the estuarine system by the local community.

The main engagement methods used were:

- Direct stakeholder engagement via correspondence;
- A public information session;
- Agency stakeholder consultation;
- Periodic meetings with the Coastal and Estuary Management Committee; and
- Periodic website updates to describe study progress.

The Preliminary Draft Plan was presented to key council staff and members of the Coastal and Estuary Management Committee to provide an opportunity to ask questions or provide direct feedback. During the public exhibition period, a community forum was held to review the process followed in the development of the Plan and discuss the Plan contents (Cardno, 2012).

Pittwater Estuary Management Plan (2010)

The local communities surrounding the Pittwater estuary were invited to contribute to the development of the Estuary Management Study phase of the EMP process. The main engagement method for this process was a community workshop. At the workshop the following main issues were identified by participants, as per BMT WBM (2010):

- Ecologically Sustainable Development (ESD) should be the overall goal of the management the estuary
- Ecology, particularly foreshore vegetation communities (including the Endangered Ecological Community Pittwater Spotted Gum Forest) seagrass beds, saltmarsh areas and birds need to be conserved.
- Adequate protection for ecologically sensitive areas through appropriate measures/actions.
- Poor water quality, particularly as a result of effluent that is discharged from boats.

- Over-use of the waterway by boats, and associated foreshore and waterway congestion and public safety issues.
- Limited public access to the foreshore.

A subsequent workshop prioritised the estuary management options and selected preferred management options (BMT WBM, 2010). An Estuary Working Group consisting of representatives from environment and community groups provided guidance in the development of the EMP. The draft Plan was presented to key stakeholders at a workshop and was placed on public exhibition for 28 days.

Gosford Beaches Coastal Zone Management Plan (2014)

A series of consultation activities were undertaken as part of the CZMP as well as the preceding Coastal Zone Management Study (WorleyParsons, 2015). During the management study the following consultation activities were undertaken:

- A series of five community forum sessions were held in order to gauge community attitude to management options, before the preferred options were presented in more detail via the CZMP. More than 270 people attended these community forums.
- Draft Coastal Management Study document made available for community review for a period of 28 days
- Promotion of the public exhibition was also made through public media releases and alerts.
- Letters were sent to 949 property owners identified as being affected by coastal hazards – as per DCP Chapter 6.2 (Coastal Frontage).

Subsequently, as part of the CZMP, a Community Engagement Strategy was developed in order to ensure that community was provided with the opportunity to gain an understanding of the planning process, coastal management issues and ensure concerns and aspirations were considered during the planning process (WorleyParsons, 2017). This was achieved through the following activities (as per WorleyParsons, 2017):

- A series of five community drop-in sessions were held to seek public feedback on the proposed management actions, and find out more about how coastal hazards will be managed now and into the future. There were 85 people recorded in attendance during these sessions.
- The draft CZMP was made available for community review for a period longer than 28 days.
- Emails sent to more than 170 groups and individuals on the project contacts database informing them of exhibition details.
- Seeking input from the community to ensure decisions made are for the long term benefit and sustainability of the community
- Taking the opportunity to educate the community on the complexities and limitations to proposed management options

A total of 19 formal submissions were received during the exhibition period.

It should be noted that there were no evaluations relating to the efficacy of the community and stakeholder engagement content, methods and outputs for the above CZMPs and EMPs.

Other Plans and Studies

It should also be noted that a vast amount of community and stakeholder engagement activities have been undertaken over the last 15 years for a range of other plans and studies that are highly relevant to the development of the CMP. The community and stakeholder engagement undertakings of the following plans were also analysed for relevant engagement insights, content and methods:

- The Marine Estate Management Strategy (MEMA, 2018);

- Pittwater Estuary - Mapping of Sea Level Rise Impacts (Cardno, 2015);
- Brisbane Water Foreshore Flood Study (Cardno, 2009);
- The NSW Water Quality and River Flow Objectives (NSW Government, 1999);
- The NSW Marine Water Quality Objectives (DECW, 2005);
- NSW Oyster Industry Sustainable Aquaculture Strategy (DPI, 2016);
- The Central Coast Regional Plan 2036 (DoP, 2017);
- A Metropolis of Three Cities – the Greater Sydney Region Plan (GSC, 2018);
- Hawkesbury-Nepean Catchment Action Plan 2013-2023 (HNCMA, 2013); and
- The Community Strategic Plans of the six (6) partner councils.

4.5.2 Local Community Engagement Strategies and Frameworks

As suggested in the engagement guidelines, the community engagement strategies from each of the six partner councils were also reviewed. These engagement strategies are:

- Central Coast Council Engagement Framework
- Hawkesbury City Council Draft Community Engagement Strategy
- The Hills Shire Council Community Engagement Strategy
- Hornsby Shire Council Engagement Strategy for the Community Strategic Plan
- Ku-ring-gai Council Community Consultation Policy
- Northern Beaches Council Community Engagement Matrix

These council engagement strategies are associated with the development and delivery of each council's Community Strategic Plan, a requirement under IP&R as legislated by the NSW Local Government Act. The engagement strategies generally comprise guidance relating to:

- Principles of engagement
- Definition of engagement
- Why do engagement?
- When to undertake engagement?
- Use of the IAP2 spectrum
- How to develop a community engagement plan
- Costs and benefits of engagement
- Monitoring and evaluation.

4.6 Stage 1 Engagement

The partner councils decided to not conduct direct community engagement in Stage 1 of the CMP process, and as a result direct community engagement will commence in Stage 2. The rationale for this was as follows:

- As described in Section 4.5, there has been a significant amount of community consultation and engagement undertaken over the last 10 to 15 years across the Brisbane Water, Pittwater, and Hawkesbury River estuaries - and their contributing catchments. This includes comprehensive community engagement undertaken for five (5) different coastal and estuary management plans that span the entire study area, as well for a range of other management plans and strategies relevant to CMP development.

- There is a significant amount of information regarding the community goals, aspirations, values and priorities for the study area available through the raft of community consultation actives described in Section 4.5. Further information on the community values of the study area is provided in Section 3.7.3 and Section 8.2. A review of previous community consultation activities provides the opportunity to provide a "stocktake" of community uses and values. Further engagement regarding the aspirations, values and priorities for the study area can be undertaken in detail during Stage 2 of the CMP.
- The raft of recent community engagement activities, and on-going communications between councils and community groups has attempted to provide the community with an understanding of the dynamic nature of coastal processes and the need to set long-term objectives. This can be further developed during direct community engagement during Stage 2 of the process.
- It is not mandatory requirement to undertake direct community consultation during Stage 1 of the CMP process. The NSW Coastal Management Manual states that "for the Stage 1 scoping study, relevant information about the community and its interests and aspirations for the coast may be drawn from results of previous community engagement or surveys".

During Stage 1, a briefing paper was provided to each of the partner councils for internal communication about the CMP process. The purpose of the briefing statement was to provide a consistent statement for each of the councils to use for internal messaging regarding the commencement of CMP, the likely timing of the process and the benefits of preparing a CMP.

As the lead CMP proponent, Hornsby Shire Council prepared a letter to the wider catchment councils, notifying them of the CMP development and the process as a whole. The briefing statement was used as the basis of this letter.

The main stakeholder engagement activities undertaken during Stage 1 comprised the holding of two (2) workshops, which were attended by the partner councils, the Stage 1 Project Steering Committee, and other councils from the wider Hawkesbury-Nepean Catchment. A brief overview of these workshops is provided below, with a more detailed summary of each provided in Appendix D.

4.6.1 Stakeholder Engagement Workshop #1

This workshop was held at Hornsby Shire Council Offices on Monday 9 September 2019. In total, 20 stakeholder representatives attended the day, from a number of different organisations including councils and state government agencies. The workshop included an initial presentation to provide background and context, and was then followed by a series of open forum, round-table discussion sessions (see Figure 4-3). The purpose of the workshop was to:

- Communicate the strategic context and drivers of the CMP;
- Confirm management roles and responsibilities across catchment and major estuaries;
- Identify the values, threats and risks across the study area; and
- Discuss the potential benefits, challenges and barriers for preparing a river system-wide CMP.

The three interactive sessions across the day involved attendees completing a series of worksheets. Each attendee was also provided a bound workbook, that provided relevant background information and additional worksheets for completion.

FIGURE 4-3 WORKSHOP DISCUSSION FORUMS AS PART OF WORKSHOP #1

4.6.2 Stakeholder Engagement Workshop #2

This workshop was held at Hornsby Council Offices on Monday 4 November 2019. The discussions held during the workshop were used to assist in the development of the CMP's Stakeholder and Community Engagement Strategy (Section 4.7). The workshop included a facilitated discussion regarding the content and methods to be included in the strategy. The workshop was around three hours in length, and was attended by at least two members of each of the partner councils: comprising one project officer, and one community engagement specialist (see Figure 4-4 and Figure 4-5).

FIGURE 4-4 WORKSHOP DISCUSSION FORUMS AS PART OF WORKSHOP #2

The workshop included an initial briefing session to provide background and context (particularly for community engagement officers who did not necessarily have a thorough background into the CMP process), and was then followed by a series of "world café sessions" to discuss content and ideas. The purpose of the workshop was to:

- Identify possible content and messages for different stakeholder audiences;
- Identify possible engagement methods for different stakeholder audiences; and
- Discuss logistics that should be considered in the CMP Stakeholder and Community Engagement Plan.

It was noted during the introductory briefing, that there exists a great deal of guidance for the development of CMP stakeholder engagement strategies in the '*Guidelines for community and stakeholder engagement in coastal management'.* Therefore, the purpose of the workshop was to engage and consult with the partner councils (and their communications engagement officers) in order to harness the local expertise and knowledge that would allow for the development of a bespoke and locally tailored engagement plan for the Hawkesbury-Nepean River system CMP.

4.6.3 Upper Catchment Council Engagement

An addition to the Stakeholder listed in Section 1.4, a number of additional councils from the upper catchment were advised of the project commencement and invited to participate in the CMP process. These councils were also provided a copy of the Draft Scoping Study Report for review and comment. These Councils include:

- Wingecarribee Shire Council
- Goulbourn-Mulwaree Council
- Upper Lachlan Shire Council
- Oberon City Council
- Lithgow City Council
- Singleton Council
- Wollongong City Council
- Liverpool City Council
- Camden Council
- Campbelltown City Council
- Cessnock City Council
- Queanbeyan-Palerang Regional Council
- Mid-western Regional Council

FIGURE 4-5 "WORLD CAFÉ" SESSIONS AS PART OF WORKSHOP #2

4.7 Community and Stakeholder Engagement Strategy

The engagement guidelines recommend that a coastal community and stakeholder engagement strategy is prepared in Stage 1 to assist in identifying how the councils and partners will engage with the community and stakeholders during the preparation of the CMP.

A community and stakeholder engagement strategy has been developed and is provided as Appendix A. As recommended in the CMP engagement guidelines, the community and stakeholder engagement strategy has considered:

- Stakeholder analysis (Section 4.3)
- Community profile (Section 4.4 and 3.7.2)
- CZMPs and associated studies (Section 4.5)
- Each council's community engagement strategies (Section 4.5)
- The local past experience and learnings of the partner councils in community and stakeholder engagement (Section 4.6.2).

It should be noted that the community and stakeholder engagement strategy is only a start and should be refined throughout the CMP process e.g. after high risk communities and user groups are identified in Stage 2. It is also suggested that each of the partner councils prepare a community engagement plan aligned to the community and stakeholder engagement strategy for the tailoring of engagement content and methods to communities in their LGA.

5 SCOPE AND STUDY AREA

5.1 Spatial Extent

5.1.1 Coastal Management Areas

As discussed in Section 3.4, the CM Act defines the area of land to be covered by a CMP – which may include any of the following four (4) coastal management areas. Each area has different characteristics and may at times overlap. These are discussed in Section 5.2 and include:

- Coastal environment area;
- Coastal use area;
- Coastal wetlands and littoral rainforests area; and
- Coastal vulnerability area.

The CM SEPP includes adopted maps for three (3) of these zones. The CM SEPP mapping of coastal environment, coastal use, and coastal wetlands and littoral rainforests areas are provided in Figure 5-1 and Figure 5-2. Mapping for the coastal vulnerability area has not been provided from the SEPP, and no such coastal vulnerability area map yet exists for the study area.

All four coastal management areas identified above are applicable to the development of the Hawkesbury-Nepean River system CMP.

The mapping of these coastal management areas may be refined during Stage 2 of the CMP. A key outcome of Stage 2 will be to provide detailed information necessary for a planning proposal to amend the mapping of coastal management areas for planning purposes in the respective partner council's Local Environmental Plans (LEP).

Some points are noted with regards to the CM SEPP mapping:

- *The intent of partner councils is to propose, each by way of a planning proposal, the adoption of a map indicating a Coastal Vulnerability Area (CVA).*
- *The existing CM SEPP mapping for coastal environment area, coastal use area, and coastal wetlands and littoral rainforests area may be amended or replaced based on the outcomes of the CMP – also through the process of making a planning proposal.*
- *As the SEPP operates at a lot-based scale for the purposes of implementing development controls, any updates to mapping for any of the four coastal management areas undertaken as part of the CMP must necessarily be developed at sufficient (lot-based) spatial resolution.*

5.1.2 Sediment Compartment

The Hawkesbury River Estuary is located within the Sydney Primary sediment compartment (Thom et al, 2018). In addition to these primary compartments, Thom et al (2018) also identify secondary compartments that form the basis of Part 1 of Schedule 1 of the CM Act. Of these, the CMP study area lies wholly within the wider *Broken Bay Coastal Sediment Compartment*, which extends from Third Point to Barrenjoey Head. The following is noted with regards to the sediment compartment:

- The adjacent sediment compartment to the south *Sydney Northern Beaches Sediment Compartment*, is situated entirely within the Northern Beaches Council LGA; and
- The adjacent sediment compartment to the north, the *Central Coast Sediment Compartment*, is situated entirely within the Central Coast Council LGA.

5.1.3 CMP Spatial Scale

The spatial extent or scale of the CMP study area is an important consideration for guiding governance and delivery of the subsequent CMP stages. Section 7.1 of this Scoping Study discusses a number of different approaches in terms of the spatial scale of the CMP study area, namely:

- LGA based CMPs;
- Estuary based CMPs; and
- A System-Wide CMP.

The advantages and disadvantages of the various spatial scales for CMP implementation are discussed in Section 7.1. Further information is provided in that Section. Based on that analysis, it is recommended that a system-wide CMP be prepared that encompasses the entire *Hawkesbury-Nepean River system*, including the Brisbane Water Estuary, the Pittwater Estuary, the Hawkesbury River Estuary, and Broken Bay.

Furthermore, it is recommended that in order to adequately identify system-wide values, pressures and risks, and to develop a coordinated approach to their management, the spatial extent of the CMP should include the upper catchment areas that extend outside of the coastal zone as defined by the CM SEPP mapping.

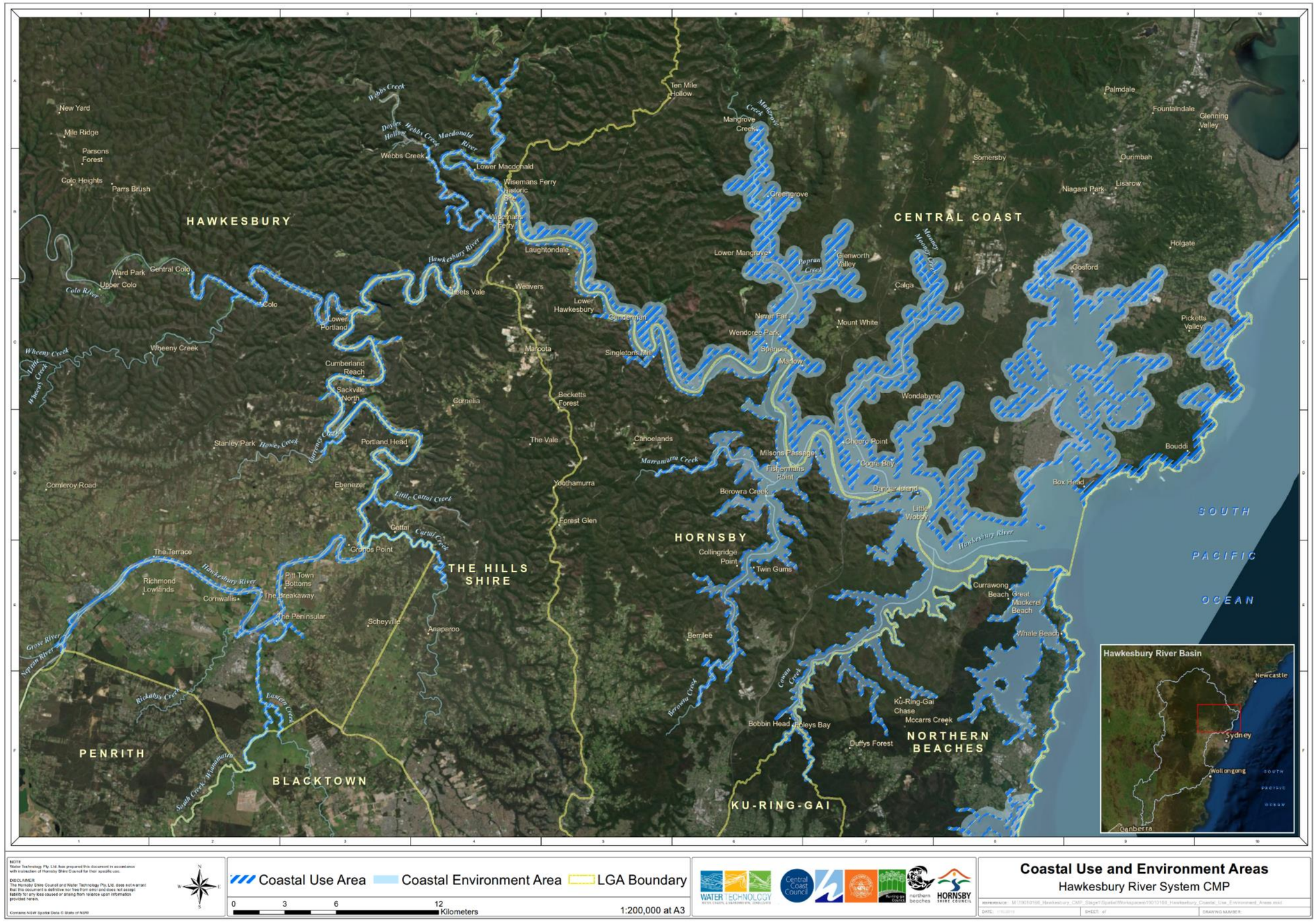


FIGURE 5-1 COASTAL ENVIRONMENT AREA AND COASTAL USE AREA

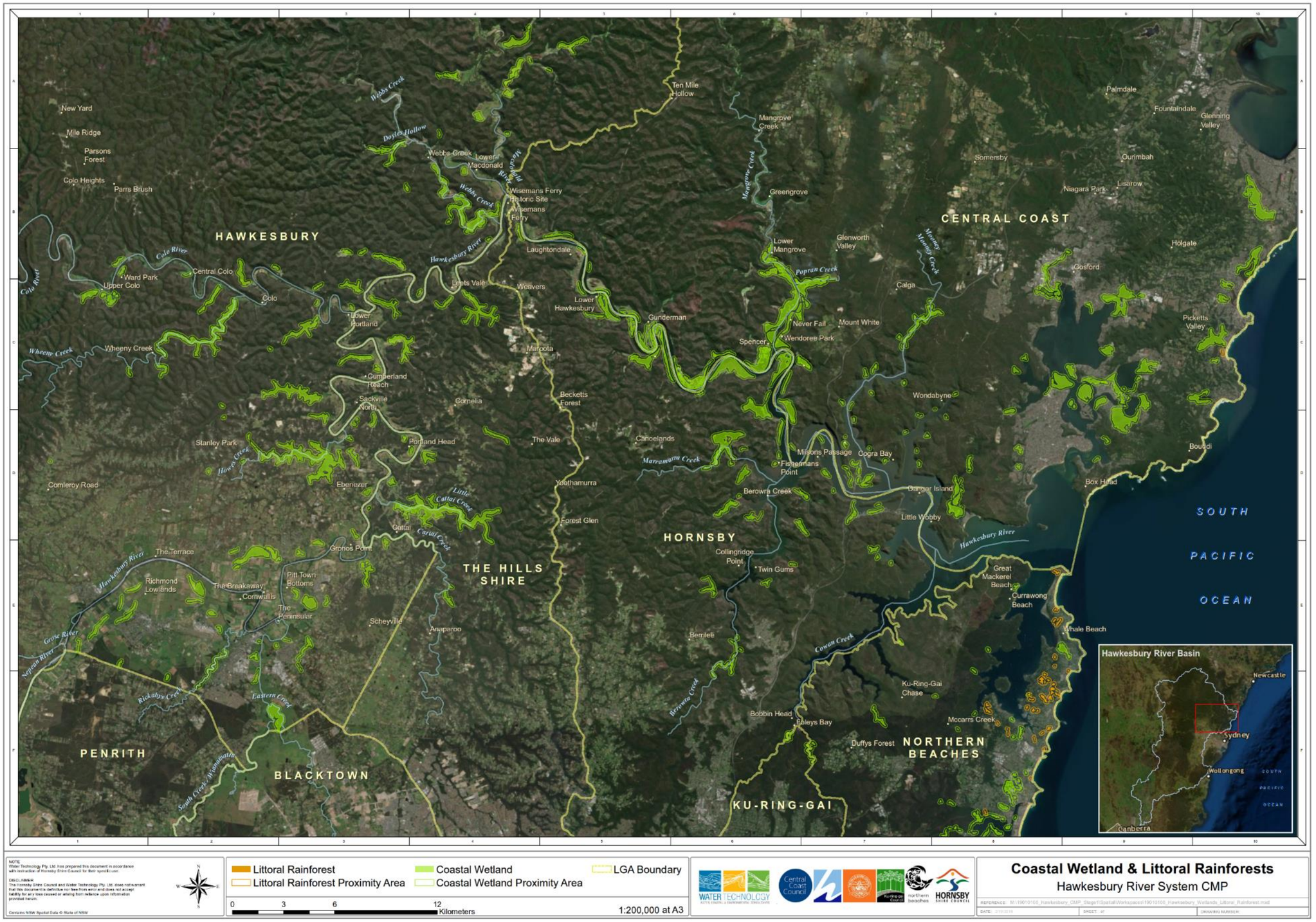


FIGURE 5-2 COASTAL WETLANDS AND LITTORAL RAINFORESTS

5.2 Coastal Management Areas

5.2.1 Coastal Environment Area

The CM Act defines the coastal environment area as land containing coastal features such as the coastal waters of the States, estuaries, coastal lakes, coastal lagoons, and land adjoining those features including headlands and rock platforms. Beaches dunes and foreshores are included in this area. Within estuaries, the coastal environment area extends upstream to the extent of tidal influence.

The area of land adjacent to the open coast, estuary or coastal lake / lagoon is also included in the coastal environment area. This is to ensure nearby development takes into account potential impacts on the coastal environment. The CM SEPP mapping for the coastal environment area therefore includes the following buffers around these coastal features for regional area such as the Central Coast:

- *For estuaries and coastal lakes:* a 500 m landwards buffer
- *For beaches, dunes, headlands, rock platforms and foreshore:* a 250 m landwards buffer.

For Greater Metropolitan Sydney, the buffer zones are:

- *For estuaries and coastal lakes:* a 100 m landwards buffer
- *For beaches, dunes, headlands, rock platforms and foreshore:* a 100 m landwards buffer.

The coastal environment area mapping provided in the CM SEPP is depicted in Figure 5-1.

The management objectives for the Coastal Environment Area provided in the CM Act are:

- to protect and enhance the coastal environmental values and natural processes of coastal waters, estuaries, coastal lakes and coastal lagoons, and enhance natural character, scenic value, biological diversity and ecosystem integrity;
- to reduce threats to and improve the resilience of coastal waters, estuaries, coastal lakes and coastal lagoons, including in response to climate change;
- to maintain and improve water quality and estuary health;
- to support the social and cultural values of coastal waters, estuaries, coastal lakes and coastal lagoons;
- to maintain the presence of beaches, dunes and the natural features of foreshores, taking into account the beach system operating at the relevant place; and
- to maintain and, where practicable, improve public access, amenity and use of beaches, foreshores, headlands and rock platforms.

5.2.2 Coastal Use Area

The CM Act defines the coastal use as being land adjacent to coastal waters, estuaries, coastal lakes and lagoons where development is or may be carried out (at present or in the future), and impacts of development on the scenic and cultural values and use and enjoyment of the beaches, foreshores, dunes, headlands, rock platforms, estuaries, lakes and the ocean need to be considered.

- In regional NSW (including the Central Coast), the coastal use area is defined as the 500 m landward extent from the open ocean boundary of LGAs, and a 250 m landward extent from the boundaries of estuaries.
- For other areas across Great Sydney, the coastal use area is defined as the 200 m landward extent from the open ocean boundary of LGAs, and a 100 m landward extent from the boundaries of estuaries.

The coastal use area mapping provided in the CM SEPP is depicted in Figure 5-1.

The management objectives for this area within the CM Act are to accommodate both urbanised and natural stretches of coastline and to protect and enhance the scenic, social and cultural values of the coast by ensuring that:

- the type, bulk, scale and size of development is appropriate for the location and natural scenic quality of the coast;
- adverse impacts on cultural and built environment heritage are avoided or mitigated;
- urban design, including water sensitive urban design, is supported and incorporated into development activities;
- adequate public open space is provided, including for recreational activities and associated infrastructure; and
- the use of the surf zone is considered.

5.2.3 Coastal Wetlands and Littoral Rainforests Area

The CM Act defines the coastal wetlands and littoral rainforests area as the land which displays the hydrological and floristic characteristics of coastal wetlands or littoral rainforests, as well as a surrounding proximity area to manage impacts of adjacent development.

Coastal wetlands mapped in NSW for the development of the CM SEPP include those that are dominated by the following vegetation types: mangroves, saltmarshes, melaleuca forests, casuarina forests, sedgelands, brackish and freshwater swamps, and wet meadows.

Littoral Rainforests are defined by their dominant vegetation which include riberry broad leaved lilly pilly, tuckeroo, brush box, yellow tulip, baurela, red olive plum, plum pine, cabbage palm and various figs.

The maps include a 100-metre proximity area, applying to all land zones around coastal wetlands and littoral rainforests. The coastal wetlands and littoral rainforests area mapping provided in the CM SEPP is depicted in Figure 5-2.

The CM Act specifies that the management objectives for this area are:

- to protect coastal wetlands and littoral rainforests in their natural state, including their biological diversity and ecosystem integrity;
- to promote the rehabilitation and restoration of degraded coastal wetlands and littoral rainforests;
- to improve the resilience of coastal wetlands and littoral rainforests to the impacts of climate change, including opportunities for migration;
- to support the social and cultural values of coastal wetlands and littoral rainforest; and
- to promote the objectives of State policies and programs for wetlands or littoral rainforest management.

Initial inspection of the CM SEPP mapping for Coastal Wetlands and Littoral Rainforests, and discussions with Central Coast Council, have indicated that mapping for the Central Coast is inaccurate in part, and will require an update during the CMP process through a planning proposal (see Section 10.3).

5.2.4 Coastal Vulnerability Area

The coastal vulnerability area (CVA) is defined in the Act as land which is subject to coastal hazards. The area focusses on identifying land subject to current and future coastal hazards, and to ensure land use management

and development undertaken in these areas recognise coastal risk and is subsequently appropriate. The Act provides for the management of seven coastal hazards:

- beach erosion;
- shoreline recession;
- coastal lake or watercourse entrance instability;
- coastal inundation;
- tidal inundation;
- coastal cliff or slope instability; and
- erosion and inundation of foreshores caused by tidal water and waves, including the interaction of those waters with catchment floodwaters.

The CM Act specifies that the management objectives for this area are to:

- ensure public safety and prevent risk to human life;
- mitigate current and future risks from coastal hazards, taking into account the effects of coastal processes and climate change;
- maintain the presence of beaches, dunes and the natural features of foreshores, taking into account the beach system operating at the relevant place;
- maintain public access, amenity and use of beaches and foreshores;
- encourage land use that reduces exposure to risks from coastal hazards, including through siting, design, construction and operational decisions;
- adopt coastal management strategies that reduce exposure to coastal hazards, in the first instance by restoring and enhancing natural defences such as coastal dunes, vegetation and wetlands; and, if that is not sufficient, by taking other action to:
  - avoid significant degradation of biological diversity and ecosystem integrity;
  - avoid significant degradation or disruption of ecological, biophysical, geological and geomorphological coastal processes;
  - avoid significant degradation of or disruption to beach and foreshore amenity and social and cultural values;
  - avoid adverse impacts on adjoining land, resources or assets; and
  - provide for the restoration of the beach or adjacent land if any increased erosion is caused by actions to reduce exposure to coastal hazards.
- prioritise actions that support the continued functionality of essential infrastructure during and immediately after a coastal hazard emergency; and
- improve the resilience of coastal development and communities by improving adaptive capacity and reducing reliance on emergency responses.

At the time of preparing this Scoping Study, there was no map published under the CM SEPP to identify the CVA in the across the study area. Therefore, planning proposals will be required to prepare LEPs for each of the partner councils that declare a map to be the CVA (based on the outcomes of the CMP).

It is important to note that the CMP hazard mapping identifies a range of risk exposures (current and future) for several different hazards (listed above). However, the CVA mapping as part of the CM SEPP selects one

of those lines (or more likely a separate line derived from several of those lines), to determine where the CVA controls will apply.

Existing Coastal Vulnerability Mapping

Coastal hazards have been assessed and mapped across the various coastlines and estuaries of the LGA through several coastal hazard studies and modelling investigations. Table 5-1 provides a summary of the existing coastal and estuarine hazard investigations undertaken for the study area. Most of these studies have been undertaken within the last ten years, however it should be noted that others are now becoming dated, and the data and methodologies underpinning these studies may not represent current best practice. Table 5-2 shows the applicability of existing studies to the various CVA components across the CMP study area.

The local risks associated with these coastal hazards are discussed in detail in Section 8.

TABLE 5-1 SUMMARY OF EXISTING COASTAL VULNERABILITY ASSESSMENTS FOR THE STUDY AREA

Study (and Associated Mapping)	Reference	Summary
Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study	Worley-Parsons, 2014	The report examines the hazards that impact the coastline between Patonga and Forresters Beach and assesses these hazards to determine the immediate, 2050 and 2100 hazard lines. In the context of this CMP the plan applies to the Broken Bay beaches of Ocean Beach, Umina Beach, Pearl Beach and Patonga Beach. The hazards examined therein include: ▪ beach erosion; ▪ shoreline recession; ▪ coastal inundation (including 100 years ARI storm tide and wave run-up); ▪ slope instability; and ▪ climate change. The study includes an assessment of future sea level rise scenarios of 0.4 m by 2050 and 0.9 m by 2100.
Modelling and Mapping of Coastal Inundation under Future Sea Level	CSIRO, 2011	This study focuses on the evaluation of coastal inundation along the Sydney coastal and estuarine regions spanned by the Sydney Coastal Councils Group. The study uses dynamic numerical modelling methods, and inundation layers span from Cowan Creek to Wisemans Ferry along the southern side of the Hawkesbury. Coastal inundation modelling and mapping was undertaken for sea levels corresponding to a 1 year and a 100 years ARI event. The study includes an assessment of future sea level rise scenarios of 0.4 m by 2050 and 0.9 m by 2100.
Pittwater Estuary Mapping of Sea Level Rise Impacts	Cardno, 2015	This study includes an assessment of coastal inundation across the Pittwater Estuary and the derivation of Estuary Planning Levels (EPLs). Inundation modelling and mapping was undertaken for tidal inundation, and coastal storm-based inundation corresponding to a 100 years ARI event. The study includes an assessment of future sea level rise scenarios of 0.4 m by 2050 and 0.9 m by 2100.
Pittwater Estuary Process Study	Lawson & Treloar, 2003	The EPS (2003) undertook an assessment of bank erosion around Pittwater. A total of 26 erosion locations were identified around

Study (and Associated Mapping)	Reference	Summary
		Pittwater, and the severity and cause of the erosion was also assessed. Subsequent investigations by DPIE (2008) and NBC have identified several additional twelve erosion sites, though no formal mapping is available.
Brisbane Water Estuary Process Study	CLT, 2009	As part of the study, an estuary wide assessment was undertaking into storm erosion and bank erosion along the estuary foreshores and pocket beaches. Modelling of six pocket beach sites located around the Brisbane Water Estuary shoreline was undertaken to investigate recession due to storm bite – including Green Point, Koolewong, and Point Clare, with a further three sites located in the vicinity of Booker Bay. These sites were considered to be representative of many reaches of shoreline of Brisbane Water and the results are therefore considered transferable in terms of indication of response.
Brisbane Water Foreshore Flood Study	Cardno, 2009 (minor revisions 2013)	The study included simulation of both catchment flood and ocean storm events with selected approximate return periods - that is, from 5 to 200 years average recurrence Interval (ARI) events, plus the Probable Maximum Flood (PMF) and the equivalent ocean storm, taken to be described by estimated 10,000-years ARI storm elevated ocean level, wind and wave parameters. Through consultation with council and DECC it was decided to assess flood planning levels under four sea level rise scenarios. These cases included 0.18 m, 0.3 m, 0.55 m and 0.91m rises over a planning period of 100 years. Based on the outcomes of the study, flood planning levels were developed along the Brisbane Water foreshore, including wave run-up for five types of edge treatment, two crest levels and roughness parameters.
Lower Hawkesbury River Riverbank Vulnerability Assessment	WRL, 2014	In 2014 WRL and Hornsby Shire Council, undertook a detailed riverbank vulnerability assessment of a 29 km section of the Lower Hawkesbury River Estuary between Wisemans Ferry and Spencer. This project was primarily undertaken to provide a new baseline for evidence-based management of riverbank erosion for Hornsby Shire Council (WRL, 2014). The study area was divided into fifty-eight (58) discrete sections of the river, each of around 500 m in length. Erosion was assessed at three representative transects on each side of the river for a total of 348 assessment sites.
Upper Hawkesbury River Bank Erosion, Foreshore Structure and Weed Mapping Report	BMT WBM, 2013a	This study assessed bank erosion along the Upper Hawkesbury River Estuary for Hawkesbury City Council, from Yarramundi to Wisemans Ferry. It is important to note that mapping only exists for the Hawkesbury LGA foreshore. Therefore, mapping and analysis was not undertaken on the eastern riverbank, in between Cattai and Wisemans Ferry. Bank erosion was identified at a total of 44 locations. At each location, erosion was assigned a severity class, bank slope gradient,

Study (and Associated Mapping)	Reference	Summary
		local land use, vegetation condition and vegetation value. An erosion potential category was then assessed for each site.
Hawkesbury-Nepean Valley Regional Flood Study Final Draft Report	WMA Water, 2019	This is a technical document describing the existing flood behaviour of the main Hawkesbury-Nepean River from Bents Basin near Wallacia downstream to Brooklyn Bridge, and the backwater flooding associated with river flooding. The regional flood study will be built on by the future development of the Hawkesbury - Nepean River Flood Study – which will progress the outcomes of the regional study into high resolution detailed two-dimensional modelling. This study is expected to be delivered by 2020-2021.

In addition to these site-specific studies, there exist several broader scale studies that assess coastal vulnerability areas. Some of these are high level, state-wide assessments that whilst not appropriate for detailed risk assessment, are useful for strategic planning and risk scoping.

The NSW Estuary Tidal Inundation Exposure Assessment was undertaken by DPIE (then NSW OEH) in 2018 (OEH, 2018c), along with associated mapping of tidal inundation extents. This undertaking represents a state-wide assessment of the impact of inundation in estuaries associated with projected SLR on the NSW coast. The aim of the study was to refine estimates of the extent of current exposure of properties and infrastructure to potential sea level rise to help assess the need for, and prioritisation of, adaptation planning and action (OEH, 2018c). The exposure assessment is limited to broadscale quantification inundation to property and infrastructure – and DPIE notes that it does not replace the need to undertake flood or inundation studies for individual estuaries and results should not be used to assess risk to individual properties and assets. Nonetheless, the study provides a high-level indication of exposure to tidal inundation.

The NSW State-wide Coastal Erosion Assessment (OEH, 2018d) provides a broad-scale overview of the potential for present and future impacts of erosion on coastal communities and infrastructure. Three methods of estimating the potential extent of present and future coastal erosion were utilised, which reflect a hierarchy of detail and resolution, including:

- Proximity analysis (First pass)
- Regional-scale modelling (Second pass)
- Local government hazard lines (Third pass)

As part of the study, a spatial analysis toolset was developed to identify properties and infrastructure that may be exposed to coastal erosion, based on the second pass and third pass analysis methods (OEH, 2018d).

TABLE 5-2 APPLICIBILITY OF EXISTING HAZARD MAPPING TO THE CVA

CVA Hazard Type	Upper Hawkesbury River	Lower Hawkesbury River	Pittwater Estuary	Brisbane Water Estuary	Broken Bay
Beach erosion	N/A	N/A	No Pittwater-wide assessment has been undertaken. However, there have been some, localised coastal hazard assessments for individual beaches including: Sand Point Beach, Palm Beach, Paradise Beach, and Great Mackerel Beach.	Brisbane Water Estuary Process Study (CLT, 2009)	Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study (WP, 2014)
Estuary foreshore erosion / bank erosion	Upper Hawkesbury River Bank Erosion, Foreshore Structure and Weed Mapping (BMT WBM, 2013b) – HCC LGA only	Lower Hawkesbury River Riverbank Vulnerability Assessment (WRL, 2014) – Wisemans Ferry to Spencer	Pittwater Estuary Process Study (L&T, 2003). Additional DPIE and Council assessments (2008)		N/A
Cliff/slope instability			Does Not Exist	N/A	Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study (WP, 2014) Pearl Beach Lagoon CZMP (BMT WBM, 2014)
Shoreline recession	N/A	N/A	N/A	N/A	
Estuary entrance instability	N/A	N/A	Great Mackerel Beach Entrance Management Strategy (MHL, 2017)	N/A	
Tidal inundation (sunny day flooding) - including SLR	Does Not Exist	Modelling and Mapping of Coastal Inundation under Future Sea Level (CSIRO, 2011) – southern foreshore only, excludes Central Coast Council area	Pittwater Estuary - Mapping of Sea Level Rise Impacts (Cardno, 2015)	Does Not Exist	
Coastal inundation (storm tide and wave run-up)	Coastal inundation does not govern flooding risk across the upper Hawkesbury River Estuary. See below.			Brisbane Water Foreshore Flood Study (Cardno, 2009)	
Estuary foreshore inundation from combined coastal and catchment flooding	Hawkesbury-Nepean Valley Regional Flood Study (WMA, 2019)	Hawkesbury-Nepean Valley Regional Flood Study (WMA, 2019) upstream of Brooklyn			N/A

6 COASTAL MANAGEMENT ARRANGEMENTS

6.1 Existing Studies and Management Plans

Over the years, several management studies and plans have been developed for the Hawkesbury River Estuary and its contributing catchment – in the form of Coastal Zone Management Plans, Estuary Management Plans and Catchment Action Plans. These plans, outlined in Section 3.5.1, have been prepared over the last 12 years and together cover most of the area this CMP covers. The development of these plans follows the structure of the previous NSW Estuary Management process (NSW, Government, 1992). Details of the previous coastal management related plans are provided below. Since the finalisation of these plans, the NSW Coastal Reforms have changed the way estuary and coastal management plans are prepared and implemented (see Section 1.2 and 1.3).

It should be noted that the CZMPs/EMPs described herein are not of equal status as not all of them have been certified under the *Coastal Management Act 2016* (formerly *Coastal Protection Act 1979*). For example, the Brisbane Water CZMP has not been certified and DPIE-Crown Lands has not provided formal agreement to the Brisbane Water CZMP, or the actions contained therein that are identified as the responsibility of DPIE-Crown Lands.

6.1.1 Upper Hawkesbury Coastal Zone Management Plan (certified)

The Upper Hawkesbury CZMP (BMT WBM, 2014a) was finalised in 2014, and covers the area between Wisemans Ferry and Yarramundi. The CZMP, commissioned by Hawkesbury City Council, provides a strategic framework and action plan for the future management of the Upper Hawkesbury River Estuary. It aims to address current issues and conserve existing values using a range of implementation mechanisms, including planning instruments, on-ground works, and education programs. The goal of the plan was to protect and improve the values and attributes of the river, which balances the pressure for development with the conservation of natural and built features.

As part of the study, a list of over one hundred potential management actions was developed - including planning controls, on-ground works and rehabilitation, economic incentives, regulation and compliance activities, investigations and education initiatives. This extensive list was developed through community and stakeholder engagement with council, stakeholders and the community - as well as through technical investigations and experience from other similar waterways. This list was assessed using a cost-benefit approach that considered economic, environmental and social aspects. A selection of 39 actions were shortlisted for inclusion in the CZMP.

The CZMP was developed progressively as the culmination of several other reports, including:

- *Upper Hawkesbury River Estuary Synthesis Report* (BMT WBM, 2013a): This report collated and reviewed background information for the estuary, including the available scientific data, existing governance framework and management initiatives. It provided a summary of estuary processes (physical and hydrodynamic, water quality, ecological and human use), values, and estuary health pressures.
- *Upper Hawkesbury River Bank Erosion, Foreshore Structure and Weed Mapping Report* (BMT WBM, 2013b): This report documented a range of studies undertaken to assess bank erosion along the Hawkesbury River between Yarramundi and Wisemans Ferry. It included water-based field data collection of bank erosion and foreshore structures, spatial mapping and analysis and a summary of key findings to inform the development of the subsequent CZMP.
- *Upper Hawkesbury River Estuary Community Consultation Report* (BMT WBM, 2013c): This report summarised the outcomes of community and stakeholder consultation undertaken to assist development

of the CZMP. The community consultation included three community meetings, a website, survey, stakeholder workshop and telephone-based discussions.

6.1.2 Lower Hawkesbury Estuary Management Plan

The Estuary Management Plan for the Lower Hawkesbury River (LHEMP) was undertaken by BMT WBM for Hornsby Shire Council and Gosford City Council (now Central Coast Council) in 2008 (BMT WBM, 2008). The purpose of the LHEMP was to provide strategic direction for future management of the Lower Hawkesbury River and its associated assets – for the estuarine reaches below Wisemans Ferry, including Berowra Creek, Cowan Creek and Mangrove Creek. The EMP was developed with the aim of combining Brooklyn and Berowra EMPs and all associated process studies. It was intended that the LHEMP would be implemented within a period of ten (10) years.

The LHEMP included an in-depth study of the processes and values of the estuary, including hydrodynamics, geomorphology, water quality, ecology (aquatic, riparian and benthic habitats), heritage (indigenous and non-indigenous) and human uses (including oyster aquaculture, commercial fishing, agriculture, recreation, and tourism). Key risks to estuary values and assets were identified through the implementation of a risk-management framework, which allowed a comparative analysis of the risks so that they could be prioritised for management decision making.

The management strategy developed by the LHEMP provides stakeholders and communities with a strategic direction for preparing, implementing and reviewing the Lower Hawkesbury Estuary Management Plan. The strategy adopts a whole of government approach that addresses the principal risks to estuarine assets, reflects community values, integrates with planning initiatives and has regard to estuarine and catchment processes (BMT WBM, 2008).

A comprehensive list of more than 800 strategies was developed through the community and stakeholder consultation, review of existing management plans and by thorough technical analysis. The list of strategies was subsequently able to be condensed to 148 distinct strategies, of which 30 were identified as high priority, to be the focus of the management plan (BMT WBM, 2008).

6.1.3 Brisbane Water Estuary Coastal Zone Management Plan

The CZMP for Brisbane Water Estuary was prepared for Gosford City Council and the Office of Environment and Heritage (OEH) by Cardno in 2012 (Cardno, 2012). The objective of the Plan was to promote sustainable, integrated estuary management for coastal ecosystem health and community uses of the coastal zone.

The Plan applies to the tidal waterway, foreshore and adjacent land of Brisbane Water, including the entrance area and tidal tributaries covering the whole region of Brisbane Water from the channel connecting the estuary to Broken Bay at the eastern end of Ocean Beach in the south; to Gosford in the north, and associated tributaries and catchments (Cardno, 2012).

The CZMP was developed progressively as the culmination of several other reports, including:

- *Brisbane Water Estuary Process Study* (CLT, 2008): This study documented the prevailing physical, ecological

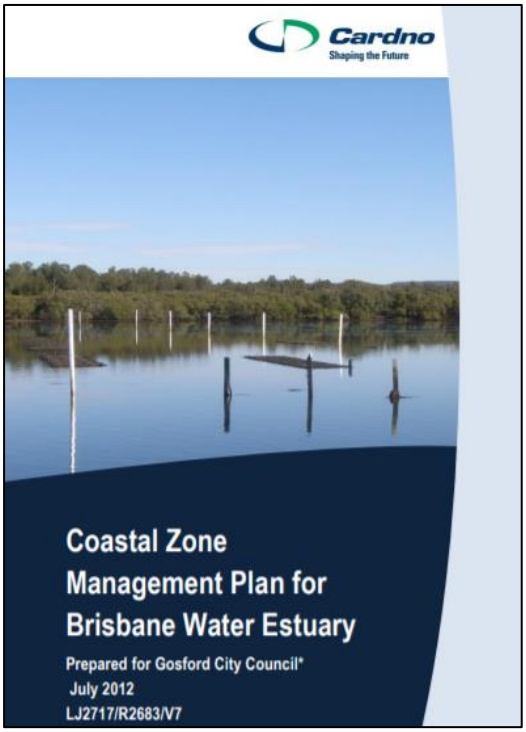


FIGURE 6-1 THE BRISBANE WATER CZMP

processes of the estuary. It included a detailed study of catchment processes, hydraulic processes (such as tidal behaviour and flushing times), estuarine morphology and siltation, water quality processes, ecological processes, cultural heritage and human uses (including recreational and economic). It also outlined the prevailing threats and pressures affecting the environmental, social and economic values of the estuary.

- *The Brisbane Water Estuary Management Study* (Cardno, 2010): The purpose of this study was to develop a suite of management actions to mitigate key estuary pressures and threats identified in the Estuary Process Study. As part of this study, a series of overarching management objectives and goals were developed in consultation with the council and the community. Management options ranged from specific works, to more overarching and long-term options (Cardno, 2010). A number of community and stakeholder consultation activities were undertaken – and the Plan has been informed by these activities and has been founded on the understanding of the values of the community (Cardno, 2010).

The CZMP adopted the recommendations of the Estuary Management Study and included a list of 183 actions for implementation. Of these, 73 were identified as high priority actions. A program of monitoring and evaluation was incorporated into the CZMP that established performance indicators and made recommendations on general monitoring activities.

6.1.4 Pittwater Estuary Management Plan

The Pittwater Estuary Management Plan (BMT WBM (2010)) was prepared for the then Pittwater Council and NSW Department of Environment, Climate Change and Water (DECCW). The purpose of the plan was to be a short, medium and long term guide to the sustainable management of the Pittwater waterway, its surrounding foreshore lands, tributaries and its catchment. The aim of the plan was to protect and maintain or improve the environmental values of Pittwater Estuary, as the environment provides the basis of the social, commercial and recreational values enjoyed by users of Pittwater Estuary. Preceding studies to the plan included:

- *Pittwater Estuary Process Study* (L&T, 2003): This study was undertaken by Lawson and Treloar in 2003. The purpose of the study was to develop an understanding of the water quality, hydraulic, sedimentary and ecological processes of the Pittwater waterway and define the interactions between the different processes. The study also identified the environmental, social, cultural and economic values of the estuary, and the key threats affecting these values.
- *Pittwater Estuary Management Study* (WBM, 2006): The purpose of this study was to identify the values, issues and objectives for the waterway. A series of management strategies were developed with the aim of maintaining and improving the environmental condition of estuary. For each of these basic strategies, a range of specific actions were considered, which relate specifically to application to the Pittwater Estuary. Strategies were prioritised based on effectiveness of meeting the management objectives and perceived environmental benefits.

The management plan was divided into eight (8) management areas considered to be of relevance to the estuary, including water quality, sedimentation and erosion, ecology, waterway usage, foreshore usage, heritage, development and climate change. A total of 41 management actions were recommended by the study, designed to achieve the 25 stated objectives for management of the estuary. The development of the plan involved a range of community and stakeholder consultation actives – including community workshops and consultation with the project's Estuary Working Group. Whilst not gazetted, it was prepared to be representative of a Coastal Zone Management Plan (CZMP) under the provisions of Part 4A of the CP Act (Rhelm, 2018).

6.1.5 Gosford Beaches Coastal Zone Management Plan (certified)

The Gosford Beaches Coastal Zone Management Plan (WorleyParsons, 2017) was undertaken for the then Gosford City Council in 2016/17. The primary objective of the plan was to protect and preserve the beach environments, beach amenity, public access and social fabric of the Open Coast and Broken Bay beaches

while managing coastal hazard risks to people and the environment (WorleyParsons, 2017). In the context of this CMP, the plan notably applies to the Broken Bay beaches of Ocean Beach, Umina Beach, Pearl Beach and Patonga Beach.

- *Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study* (WorleyParsons, 2014): This study comprised a coastal risk assessment, which was undertaken to describe the coastal processes and associated hazards that impact the Gosford coastline and provide an assessment of the risks to life and property posed by these hazards. The coastal hazards considered within included beach erosion, shoreline recession; sand drift; coastal inundation; stormwater erosion; climate change; and slope and cliff instability hazard. The study included consideration of current and future conditions (2050 and 2100) to include future impacts of projected climate changes (WorleyParsons, 2017).
- *Open Coast and Broken Bay Beaches Coastal Zone Management Study* (WorleyParsons, 2015): Having defined the type, nature and significance of coastline hazards, the Coastal Zone Management Study was the next step to be undertaken to identify options relevant to the environmental planning and management of the area (WorleyParsons, 2015). The outcome of the Study was a defined and prioritised set of coastal management options to address specific management issues for each beach in the LGA – including those in Broken Bay that are within the CMP study area.

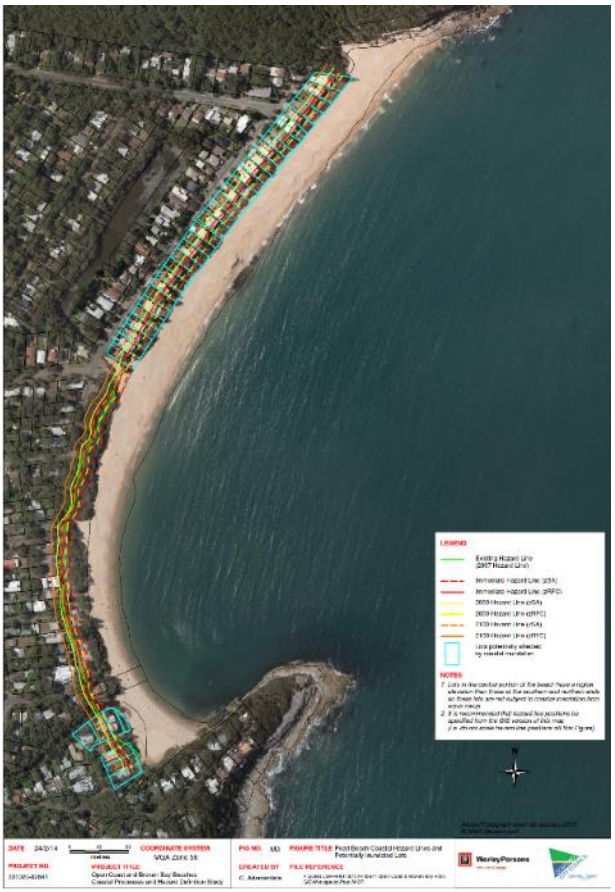


FIGURE 6-2 COASTAL HAZARD STUDY: MAPPING FOR PEARL BEACH

For this CZMP, management actions were developed for each beach based on the specific coastal hazard risks identified along each beach, the values in the study area, the effectiveness of the existing coastal management measures, and specific issues of importance identified by the local community and in previous studies (WorleyParsons, 2017). In addition to site-specific management actions, more general management actions were included that apply on an LGA-wide basis. The plan includes 26 actions for Patonga Beach, 37 for Pearl Beach, and 49 for the Ocean/Umina beach embayment.

The plan included a large component of community and stakeholder engagement. Council actively sought input from the wider community in the development of the Management Study and the CZMP. Feedback obtained through engagement activities provided direction on preferred management approaches, and assisted to ensure all relevant factors were sufficiently considered and integrated into the planning process (WorleyParsons, 2017).

6.1.6 Pearl Beach Lagoon Coastal Zone Management Plan (certified)

The Pearl Beach Lagoon Coastal Zone Management Plan was undertaken for (the then) Gosford City Council in 2014 (BMT WBM, 2014b). The CZMP provides a strategic framework and action plan for future management of the Lagoon. The objective of the CZMP was to improve the health of the lagoon in relation to water quality, fringing vegetation and habitat (including the Melaleuca wetland), improve diversity and abundance of native wetland fauna (including waterbirds), protection and enhancement of visual amenity, and maintain public

access. The CZMP follows from the Pearl Beach Lagoon Condition Study and Community Uses Report (BMT WBM, 2012), which identified the characteristics of the lagoon and the prevailing physical processes.

The CZMP identified a number of threats and health pressures facing the lagoon including stormwater pollution, weed invasion, lagoon sedimentation, climate change and algal blooms. Consequently, the Plan identified nine (9) management actions designed to manage the aforementioned pressures and achieve the objective(s) of the CZMP (BMT WBM, 2014b).

6.2 Implementation of Existing Management Plans

As part of this scoping study, an audit was undertaken of the recommended actions and strategies put forth in the various management plans listed above. This audit was undertaken in consultation with information provided by the partner councils and Project Steering Committee, and was undertaken on over 500 discrete actions recommended in the following documents:

- Upper Hawkesbury Coastal Zone Management Plan: 39 Actions
- Lower Hawkesbury Estuary Management Plan: 147 Actions
- Brisbane Water Estuary Coastal Zone Management Plan:183 Actions
- Pittwater Estuary Management Plan: 41 Actions
- Gosford Beaches Coastal Zone Management Plan: 111 Actions for the Broken Bay Beaches
- Pearl Beach Lagoon Coastal Zone Management Plan: 9 Actions

The results of the audit are provided in Appendix E. For each action item within each plan, information has been provided regarding the current status of that action – with a designation that fits into one of six (6) categories:

- ***Completed (Code: C):*** Where discrete (one-off) actions items have been completed and no further actions is required.
- ***Implemented and Ongoing (Code: O):*** Where actions have an ongoing component and are currently being enacted.
- ***In progress / Incomplete (Code: IP):*** This includes actions that are in progress.
- ***Not Commenced / Outstanding (Code: NC):*** Where outstanding actions have not yet commenced - but have been marked for future implementation.
- ***No Longer Applicable (Code NLA):*** Where actions are no longer applicable due to changed circumstances or superseding actions from other management plans.
- ***Unknown (Code U):*** Actions where the status is unknown or do not necessarily fit into the above categories.

A summary of the audit is provided in Table 6-1, which provides a breakdown of action implementation across the various management plans.

TABLE 6-1 SUMMARY OF MANAGEMENT PLAN AUDIT

Plan	Total Actions	C	O	IP	NC	NLA	U
Upper Hawkesbury CZMP 2014	39	1 (3%)	16 (41%)	13 (33%)	8 (21%)	0 (0%)	1 (3%)
Lower Hawkesbury EMP 2008	147	20 (14%)	75 (51%)	34 (23%)	13 (9%)	0 (0%)	5 (3%)
Brisbane Water CZMP 2012	183	31 (17%)	68 (37%)	15 (8%)	66 (36%)	0 (0%)	3 (2%)
Pittwater EMP 2010	41	0 (0%)	28 (68%)	8 (20%)	5 (12%)	0 (0%)	0 (0%)
Gosford Beaches CZMP 2014	111	13 (12%)	39 (35%)	9 (8%)	36 (32%)	2 (2%)	12 (11%)
Pearl Beach Lagoon CZMP 2014	9	0 (0%)	3 (33%)	4 (44%)	2 (22%)	0 (0%)	0 (0%)
Total	**560**	**12%**	**43%**	**16%**	**25%**	**<1%**	**4%**

The partner councils have given effect to many of these actions through their IP&R frameworks and are manifest in their Delivery Programs and annual operational plans.

Results in this table and Appendix E show that most actions recommended in the plans have been undertaken or are currently ongoing. A number of these actions have generated positive environmental and socio-economic outcomes when compared to their intended monitoring indicators.

6.3 Monitoring Programs

Core estuary condition indicators are currently monitored by a range of local and state government organisations at over 50 locations throughout the estuarine reach of study area. These are depicted in Figure 6-3 and include:

- 9 sites across Brisbane Water (by Central Coast Council)
- 5 sites across Pittwater (by Northern Beaches Council)
- 24 sites across the Lower Hawkesbury and Broken Bay (including 8 by Central Coast Council, 14 by Hornsby Council and 2 by Sydney Water); and
- 15 sites across the Upper Hawkesbury from Wisemans Ferry to Yarramundi (including 10 by Sydney Water and 5 by Hawkesbury City Council and DPIE)

Two key water quality indicators, turbidity and *chlorophyll a,* are monitored to represent water quality condition – based on the findings of Scanes et al. (2007). Both are nationally agreed indicators for monitoring water quality and can be assessed by comparing data against relevant trigger values suggested in the Australian water quality guidelines (ANZECC &, ARMCANZ 2000). Estuarine macrophyte and fish assemblage data also provide a longer-term integration of estuary ecosystem health status (OEH, 2016).

It is worth noting that the sites listed above are estuarine sites but several Councils (such as at least Northern Beaches, Central Coast and Hornsby Shire) also monitor a number of additional freshwater sampling sites - which are key in informing catchment health estuary impacts.

FIGURE 6-3 WATER QUALITY MONITORING SITES ACROSS THE ESTUARY REACH

A number of other additional water quality monitoring programs are in place across the study area, including:

- *The NSW Beachwatch* water quality program monitors and reports recreational water quality at three (3) Broken Bay beaches (Pearl Beach, Ocean Beach and Umina Beach), four (4) beaches within Brisbane Water, and ten (10) beaches within Pittwater. This is undertaken as part of a wider program that monitors water quality at 132 swimming locations across Sydney, Hunter and Illawarra regions (OEH, 2019d). The program provides daily pollution forecasts and advice on recreational water quality, along with weekly star ratings, and annual beach grades which are reported each year in the *NSW State of the Beaches* report.
- *The Sydney Water Sewage Treatment System Impact Monitoring Program (STSIMP)*: This program was developed in conjunction with (then) OEH, and commenced in 2008 to satisfy condition M5.1a of Sydney Waters EPLs. The results are reported to the NSW EPA every year. The STSIMP aims to monitor the environment within Sydney Water's area of operations to determine general trends in water quality over time (Sydney Water, 2018). Sampling is undertaken at eighteen sites (including those depicted in Figure 6-3 above) every three weeks for parameters including chlorophyll-a, algal identification and associated nutrients. In addition to this, freshwater macroinvertebrate sampling is undertaken at thirty-two sites, twice per year (Sydney Water, 2018).
- *Ku-ring-gai Council Water Quality and Aquatic Macroinvertebrate Sampling:* Since 1998, Council has conducted water quality monitoring and macroinvertebrate sampling across the LGA, at monitoring sites representative of Ku-ring-gai's aquatic ecosystems (KC, 2016). A quarterly report card is produced presenting progress and results against key indicators.
- *Hornsby Council "Hawkesbury Watch" Water Quality Monitoring Program:* Hornsby Shire Council has monitored water quality to assess aquatic ecosystem health since 1994. Council carries out a comprehensive water quality monitoring program, including in-situ sampling at >60 locations around the LGA. This program is one of the most intensive monitoring programs undertaken by any Local Government in NSW with the information used to inform management, compliance and education activities, subsequently relieving pressures on local waterways and protecting community values. A total of 34 long-term freshwater and estuarine sites recently analysed as part of Councils 'Waterway health review' (HSC,

2019a) This Review describes the (relatively) long-term trends in water quality and how it conforms to guideline values at 35 sampling sites, which have been monitored monthly for up to 22 years (1995 to 2017). Data was compared to Hornsby Shire Council's freshwater and estuarine Regional Environmental Health Values (REHVs) which have been specifically developed to assess water quality in the region.

Analysis of the long-term data set for this Review has identified a range of management actions required to protect, mitigate or remediate catchments in order to protect local waterways and their associated community values.

In 2017 Council commenced a catchment health program called EcoHealth which involves water quality monitoring, riparian vegetation assessments, geomorphological condition and macroinvertebrate sampling. Council also undertake public health monitoring at recreational sites (bacteria- beachwatch type and algal bloom monitoring); stormwater harvesting; monitoring at former landfill sites and Catchment remediation device performance. Council also utilises six real-time monitoring stations along the estuary, sampling at 15-minute resolution (HSC, 2019c)

- *Central Coast Council Waterways Monitoring:* Council has established comprehensive ecological health monitoring programs for all its waterways, including the Hawkesbury River and Brisbane Water. Central Coast Council also monitors on-site sewage management systems throughout the LGA, including 80 pump-out systems, 1,636 aerated wastewater treatment systems, 2,878 septic tank systems with irrigation areas, and approximately 40 commercial systems and 38 miscellaneous systems (GCC, 2015).
- *WaterNSW* has a comprehensive water quality and quantity monitoring program (WMP) across the upper The WMP has been developed in collaboration with NSW Health, Sydney Water and other stakeholders (WaterNSW, 2016). The program incorporates locations, frequency benchmarks or guideline values for more than 200 water quality characteristics – and includes routine and event monitoring employing field sampling, laboratory testing and telemetered 'real-time' data collection.

Additionally, several citizen science water quality monitory programs are in place across the study area, including:

- *Streamwatch* (part of the Greater Sydney Landcare Network)*:* Streamwatch is a long running water monitoring program initiated by Sydney Water and the (then) Sydney Catchment Authority. Streamwatch undertakes water monitoring at over 50 sites across the Hawkesbury-Nepean catchment. The Streamwatch dataset includes physical and chemical parameters collected during the period from 1990 to 2018 collected monthly by trained volunteers (Streamwatch, 2019). *Waterwatch* is the name applied to the Streamwatch for all areas outside of Sydney Water's Operation (including the Central Coast).

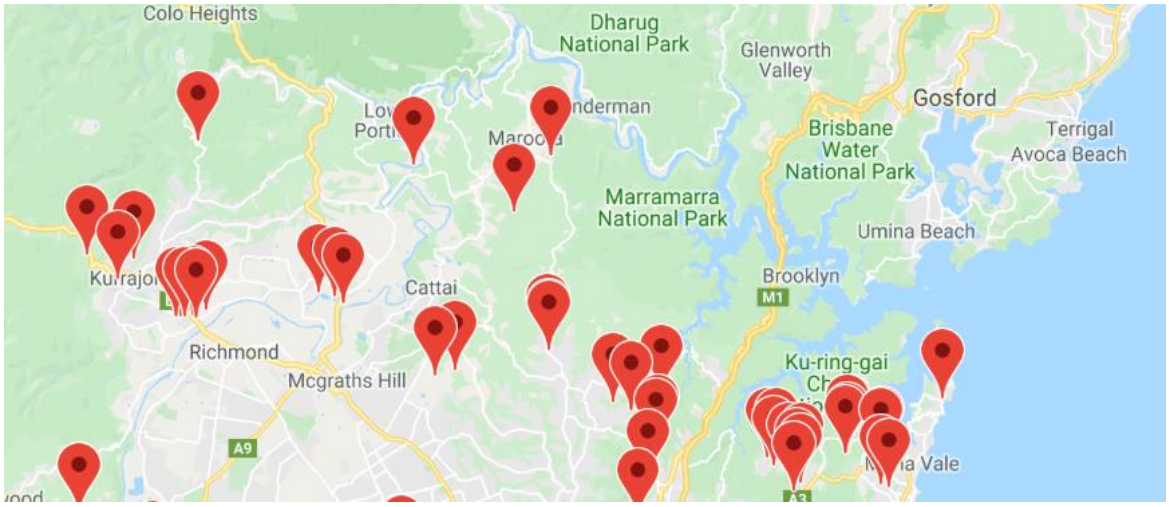


FIGURE 6-4 STREAMWATCH WATER MONITORING SITES ACROSS THE STUDY AREA

6.4 Challenges and Opportunities for Estuary and Catchment Management

During the Stakeholder Engagement Phase of the study (Workshop #1), a high-level review of the various roles and responsibilities of project stakeholders was undertaken (see Section 4.6). As part of the workshop, each of the stakeholder organisations provided insight regarding:

- An overarching description of the roles & responsibilities across the Brisbane Water, Pittwater, and Hawkesbury River estuaries and their catchments;
- Managerial and planning linkages with other organisations/agencies;
- The desired outcomes for coastal and estuary management;
- The challenges to delivery of these actions; and
- Key learnings and opportunities for improvement going forwards.

A summary of the governance arrangements, and the roles and responsibilities of the various local governments and state agencies is provided in Section 3.3. This section provides a high-level summary of the major ***challenges*** and ***opportunities*** for implementation of catchment and estuary management. It is intended as a broad overview of the major themes and overarching issues provided by the project stakeholders.

For both local and state government agencies, a lack of funding was consistently identified as a barrier to the derivation and implementation of management actions. In particular, local councils often have insufficient funds available to undertake necessary studies, develop management plans and implement the actions identified therein – particularly those relating to capital and maintenance works. Even with state government funding assistance, this lack of funding often results in the delay of requisite studies, and an ad hoc development and implementation of management plans. However, there are opportunities for the CMP to act as a vehicle for funding through the NSW Coast and Estuary grants program. Additionally, the adoption of a whole-of-system Hawkesbury River CMP represents an opportunity to access funding to tackle larger, whole-of-estuary issues that could not be addressed by smaller, individual, studies and plans. The CMP can be used to identify priorities for investment across the estuary, in order to ensure that high priority issues addressed are not stymied by the funding limitations of any particular council.

Another major barrier identified by the project stakeholders was the lack of coordination across the river system between estuary councils, upper catchment councils, and state government agencies. This lack of coordination inhibits the effective management of system wide issues. This also hinders knowledge and data sharing and impedes the development of a higher level of understanding of the interconnected nature of the system-scale pressures affecting the system. Lack of coordination also results in the application of inconsistent approaches to estuary management across the system - particularly between estuary councils, but also across the various catchment councils. The stakeholder engagement workshop also revealed that there is a lack of understanding of the objectives of the various land managers across the study area (councils, Crown Lands, NPWS in particular), and at times competing objectives that represent a barrier to the coordinated and effective management of the catchment and estuaries. A result of this, there is a significant amount of jurisdictional ambiguity across river system and its tributaries. Therefore, the CMP process should be undertaken with a vision of establishing pathways and processes for improved coordination and a consistent overarching direction across the various bodies managing the Hawkesbury-Nepean River system - both amongst internal council units and across state agencies.

The funding and coordination issues outlined above generate strain on resources that are required to ensure proper compliance with existing rules and regulations. Many stakeholders identified unclear and/or inadequate regulation, and a lack of compliance effort as a major challenge for effective management of the river system and its catchment. It is anticipated that the CMP can facilitate a more coordinated approach to compliance regulation and provide avenues for funding to adequately resource and target compliance effort across agencies.

Many of the project stakeholders noted that there are many areas where additional knowledge is required to support a better understanding of risk and to inform decision making. These knowledge gaps relate to a number of environmental, social and economic information categories. The CMP represents an opportunity to establish a collaborative approach to knowledge sharing across organisations, and to coordinate and implement data collection and the commissioning of system-wide studies and monitoring programs to fill knowledge gaps.

Coastal hazards were also identified as a significant barrier to effective coastal zone and catchment management and represent a risk to asset management and maintenance. A recent example of this is the series of storm erosion episodes between 2015 and 2016 which severely impacted the Ocean/Umina Beach, and other public assets. In the aftermath of these storms, Gosford City Council enacted a series of responses including ongoing beach monitoring program, a temporary geotextile sandbag seawall wall covering over 100m of beach, and an ongoing beach scraping program to provide erosion buffer and beach amenity.

Other natural hazards include tidal inundation, catchment flooding and inundation, bushfires and (potentially) tsunami. These natural hazards can represent irregular and episodic challenges that often require emergency management and funding. Furthermore, it is expected that increased pressure from such emergencies/disasters is likely to occur in the future due to climate change. The frequency and intensity of natural disasters such as East Coast Lows and associated coastal and catchment flooding impacts are likely to create additional pressure to the implementation of effective coastal zone management over future planning horizons. As such, the development of the CMP can be used to identify high priorities for climate change adaptation measures associated with coastal and catchment risk management.

Population pressures have also been identified as a significant challenge to management of the river system. As discussed in Section 3.7, Western Sydney is planned as a major growth corridor for the state over the coming decades, and much of this development will occur within the Hawkesbury-Nepean catchment. These pressures will manifest themselves in a number of ways over management timeframes. Development pressure and urbanisation will have significant impacts on quantity and quality of urban runoff and industrial discharge into the receiving waters of the upper estuary impacting on water quality. Additionally, these population pressures will increase demand for recreational use of the waterway (particularly across Pittwater, Brisbane Water and Wisemans Ferry), leading to recreational use and user conflicts – particularly during peak periods.

7 CMP DELIVERY AND GOVERNANCE STRUCTURE

7.1 Spatial Scale of CMP Delivery

The spatial extent or scale of the CMP study area is an important consideration for guiding governance and delivery of the subsequent CMP stages. The geographical distribution of CMPs within or across a study area is based on consideration of a number of environmental, social and governance issues. Under the CM Act, CMPs are required to take a "systems" approach to coastal management. This means that the study area for the CMP needs to recognise that important physical and ecological systems extend across the catchment, coastline, estuaries and foreshore of the Hawkesbury-Nepean River system – including water quality, ecological processes, coastal and catchment flooding, development pressures and local and regional planning initiatives. Consequently, the study area for a CMP needs to be large enough to adequately address issues that exist on a system wide scale. However, the study area should not be so large that it lacks the required granularity and cannot adequately identify and address smaller, localised issues. The determination the spatial scale of a CMP should aim to balance these considerations

The advantages and disadvantages of the various spatial scales for CMP implementation are discussed below in Section 7.1.1 to 7.1.3. Based on that analysis, it is recommended that a system-wide CMP be prepared that encompasses the entire Hawkesbury-Nepean River system, including the Brisbane Water Estuary, the Pittwater Estuary, the Hawkesbury River Estuary, and Broken Bay.

Nonetheless, the project Steering Committee will periodically review the geographic scope of the final CMP as Stages 2 to 4 are progressed

7.1.1 LGA Based CMPs

This approach would comprise the development of a series of LGA based CMPs, one developed by each of the partner councils (six in total). The benefit of such an approach is that it can potentially afford greater granularity in the assessment of smaller scale local issues and ensure that these are targeted and addressed. The smaller scope would involve fewer stakeholders, and with a smaller and more agile CMP governance structure, would provide each local council with greater control of the content and issues addressed in the CMP.

However, this approach also has major deficiencies. Notably, the approach lacks the ability to adequately address major system-wide issues and threats, as it does not easily facilitate coordination between the various councils and agencies acting across the system. It may therefore result in inconsistent management approaches being applied across each CMP. Opportunities for economies of scale would also be lost and there would be inefficiencies associated with councils having to contact neighbouring councils for issues that span their own LGA. Therefore, this approach was not recommended.

7.1.2 Estuary Based CMPs

This approach would involve the development of estuary based CMPs, and would likely involve the development of three to four programs covering (respectively) the estuaries of Pittwater, Brisbane Water, Lower Hawkesbury, and Upper Hawkesbury (or a combination of the last two as one estuary system). This has been the historical approach to the management of these waterbodies. The rationale for such an approach is that it allows smaller scale local issues to be addressed, whilst maintaining the scale required to address larger issues affecting the estuaries.

However, an estuary scale approach would also be hamstrung by not being able to easily respond to river system impacts that originate outside confined boundaries (e.g. water quality). This approach would lack the ability to effectively address system wide issues and integrate with regional planning initiatives (such as the Central Coast and Greater Sydney Region Plans). Importantly, estuary scale CMPs would be of a significantly

smaller platform than a system-wide model, and may lack the political heft to gain government and/or private funds to address bigger issues.

It should be noted that this approach has historically resulted in a lack of coordination amongst estuary councils, catchment councils and state agencies, as discussed in Section 6. This has resulted in significant jurisdictional ambiguity across the estuary system, and the status quo approach may lack the scope to address these governance issues. Therefore, this approach is not recommended for an efficient CMP.

7.1.3 A System-Wide CMP

Based on the discussions provided herein, the Project Steering Committee has decided to adopt a system-wide approach to the CMP. *The study area for the CMP therefore extends across the entire Hawkesbury-Nepean River system including the Brisbane Water Estuary, Pittwater Estuary, Hawkesbury River Estuary and Broken Bay - and its contributing catchment* (see Section 5).

Nonetheless, it has been acknowledged by the Project Steering Committee that such an approach will present its own opportunities and constraints. Subsequently, the first stakeholder workshop of Stage 1 (see Section 4.6) included a Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis of the use of the river system-wide approach. As shown in Table 7-1, the stakeholder workshop found several positive and negative attributes to a river-system approach.

Overall, there were a number of significant advantages identified in proceeding with a system-wide CMP. This approach would provide a vehicle for the coordinated and strategic management of the river system, and create a program that can more effectively and efficiently address catchment scale issues, threats & risks. This approach would also more easily foster alignment with regional and strategic planning initiatives.

From a governance perspective, a system-wide CMP would more efficiently improve coordination & collaboration across the multitude of stakeholders with managerial responsibilities across the coastal zone and catchment (see Section 3.3). This approach would provide an integrated and clearly defined governance structure that can reduce jurisdictional ambiguity across these organisations. A large scale system-wide CMP would also provide a stronger political voice, and would increase the likelihood of meaningful engagement and integration with upper catchment stakeholders. Given the depth and breadth of catchment based risks and threats facing the estuary, this is deemed to be an important outcome of a system-wide approach.

Furthermore, there may be significant cost savings associated with this approach, compared to developing multiple CMPs with an estuary-based approach. A system-wide CMP would be able to harness cost advantages associated with economies of scale during Stages 2 and 3, and avoid costs associated with duplication of studies & plans across the various estuaries. From a funding perspective, the CMP could provide a greater platform for attracting government and/or private funds to address larger (catchment scale) issues and threats – and can reduce likelihood of the vision and scope of a CMP being limited by individual council budget constraints.

A potential constraint identified by some stakeholders was that the geographic scale of the CMP (which is very large) may result in a loss of detail and granularity at a local level when identifying key issues and management actions. In order to ensure that a Hawkesbury-Nepean River system CMP remains effective at a local level, the CMP could be structured to support the addressing of local scale issues. One approach could be to implement a multi-tiered structure for the CMP - whereby the system-wide CMP could establish shared goals and objectives, with a secondary tier of estuary scale sub-plans developed to address smaller scale local issues. This could include the following structure:

- *The Hawkesbury-Nepean River system CMP:* The overarching CMP can establish the shared goals, objectives and governance structure for the CMP. The CMP could establish the roles and responsibilities, and a series of actions to address system-wide issues and threats. It would remain the vehicle to foster coordination across the catchment and estuary councils and the multitude of stakeholder agencies.

- *Estuary Scale Sub-Programs:* Within the overarching CMP, a series of estuary scale sub-plans could be developed that implement the overarching system-wide goals and direction, whilst achieving the required detail and granularity to address local issues. The estuary scale sub-plans could focus on delivery of short-medium term actions aligned with the Community Strategic Plan SP and delivery program of each partner council LGA.

It was acknowledged during the workshop that the Sydney Harbour CMP is presently adopting a system-wide, whole of estuary approach. Whilst not entirely similar, there is some commonality between the various threats and issues facing the Sydney Harbour Estuary, and the significant suite of project stakeholders. Much like the Hawkesbury-Nepean River system, the application of a system-wide CMP for Sydney Harbour has been intended to address whole-of-catchment issues and capitalise on opportunities available through collaboration and new partnerships (BMT WBM, 2018).

Although there were some potential constraints identified to the river system-wide approach, the stakeholder workshop demonstrated in-principle support for a systems wide CMP – including from the project steering committee, LALCs, state government agencies and upper catchment councils

TABLE 7-1 SWOT ANALYSIS FOR USING SYSTEM-WIDE APPROACH FOR CMP GOVERNANCE

Internal Origin (attributes of the CMP Structure)	Positive	Negative
	Strengths ▪ The CMP would be the vehicle for the coordinated and strategic management of the river system ▪ Can more effectively and efficiently address catchment scale issues, threats & risks ▪ Reduces likelihood of the vision and scope of a CMP being limited by council budget constraints ▪ Encourages / improves coordination & collaboration across agencies ▪ Can reduce jurisdictional ambiguity across organisations ▪ Allows development of consistency across the system in addressing common (but localised) issues ▪ Avoids duplication of studies & plans ▪ The CMP could be structured to support the addressing of local scale issues. ▪ The stakeholders across the upper catchment becomes more invested ▪ Provides a stronger political voice	**Weaknesses** ▪ Reaching agreement on a CMP funding model may be difficult ▪ Internal resistance – overcoming individualism of relevant councils ▪ Different levels of commitment and capacity from different organisations ▪ Time-commitment, organisation and governance becomes more complex with an increasing number of parties and partners ▪ Potential inequality in funding and priorities across LGAs

	Positive	Negative
External origin (attribute of the environment)	**Opportunities** ▪ CM Act requires CMPs to take a systems approach to coastal management, which looks at coastal, estuary and catchment issues in a broader and strategic context ▪ Cost advantages associated with economies of scale for developing Stages 2 and 3 ▪ A greater platform for attracting government and/or private funds to address bigger issues ▪ Information sharing and co-ordination to harness collective knowledge ▪ Enables alignment with other strategic plans e.g. Central Coast Regional Plan and Greater Sydney Regional Plan	**Threats** ▪ If not properly managed, the governance may become unwieldy due to the sheer number of stakeholders ▪ CMP management options may become too generic and not local enough ▪ A large study area can be a barrier to effective integration ▪ May be more difficult to capture & manage local issues ▪ May not obtain local community buy-in ▪ Different community values and interests across several LGAs ▪ Local politicians may undermine the CMP process ▪ Lack of understanding of 'catchment' particularly in upstream LGAs

7.2 CMP Governance

The NSW Coastal Management Manual Part B, Stage 1 (OEH, 2018a) requires that governance arrangements be established, not only for Stage 1 of the CMP, but also for the subsequent stages.

Section 1.5 describes the governance structure used in Stage 1. It comprises a project steering committee consisting of the six partner local councils, relevant state government organisations and LALCs. Stakeholders in the upper Hawkesbury-Nepean catchment (i.e. outside the study area) were also consulted in Stage 1 (see Section 1.5).

Section 3.3 outlines the roles and responsibilities of stakeholder organisations including those represented on the Stage 1 project steering committee. Section 4 provides an analysis of other stakeholders, including community members, community groups and business groups.

With numerous potential stakeholders that could be represented, there are several possible governance structures that could be considered for future CMP stages. Other governance structure arrangements that could be considered include:

- Cooperative organisations of local councils. For example, the Georges Riverkeeper is the business name of the Georges River Combined Council's Committee Incorporated (GRCCC). The Riverkeeper was formed in 1979 and comprises eight member councils which span the Georges River Catchment, namely Bayside Council, Campbelltown City Council, City of Canterbury Bankstown, Fairfield City Council, Georges River Council, Liverpool City Council, Sutherland Shire Council and Wollondilly Shire Council. It also includes representation from state government agencies, and community groups. The Riverkeeper is tasked with a collective responsibility for the health of the Georges River, and to work together to improve its environmental condition and ongoing management (GR, 2019). It is an independent and non-for-profit organisation governed by the Georges Riverkeeper Executive Group, who is elected annually and meet monthly. The Georges Riverkeeper is presently managing the development of the Georges River CMP.

- Formal alliances of local and state government agencies and the community. For example, the Parramatta River Catchment Group (PRCG) is an alliance of local and state government agencies and community groups that provides an overarching strategic and coordination role for the catchment (BMT WBM, 2018). Financial members of the PRCG comprise local councils in the catchment, as well as selected state government agencies. Non-financial members include five elected community members.
- Building on existing governance structures. As described in Section 1.5, the Lower Hawkesbury Estuary Management Plan Committee (LHEMPC) is comprised of representatives from multiple tiers of government, local industry groups and communities, and covers part of the study area (Hornsby Shire, Central Coast and Hawkesbury City LGAs).

7.2.1 Recommended Governance Structure

Sections 3.3 and 4.3 provide an analysis of potential stakeholders that could be represented in governance of the CMP. This analysis confirms that the overall governance structure should include the six partner councils, relevant state government agencies, LALCs, and councils from the wider Hawkesbury-Nepean catchment. The proposed governance structure is described below and summarised in Figure 7-1 and Table 7-2.

The governance structure comprises a multi-tiered approach, including:

- A decision-making tier: Comprising a project steering committee;
- A technical advice tier: Comprising technical advice from upper catchment councils, relevant agencies, community groups and traditional owners; and
- A major project tier: Comprises of combinations of the above, to be utilised as necessary.

The Project Steering Committee

In terms of governance arrangements, it is recommended that the current arrangement of the project being led by a *project steering committee* should be retained in preference to more formal arrangements (e.g. Riverkeeper, PRCG) or extending existing committees (e.g. LHEMPC) which do not have the scope of interest or scale required for river system-wide CMP development. The current arrangement allows for flexibility in composition and enables the committee to easily adapt to future needs as it is not burdened by legal arrangements. However, it will require consistent future buy-in from all stakeholders in the project steering committee, particularly from the six partner councils.

The project steering committee would be responsible for decision making throughout the CMP and ensuring delivery of project outcomes. It is recommended that the steering committee be comprised of the six partner councils and DPIE (EES). It is preferable that each Council is represented by a management representative to ensure buy-in to the CMP process, while also enabling support of decision-making and project delivery through ongoing discussion with the executive of individual councils. It is noted that this project steering committee is leaner than that which has been adopted for Stage 1 (see Section 1.5), at least initially. The intention of keeping the steering committee as lean as possible is to ensure that it functions as an efficient decision-making team that still reflects the diverse viewpoints of project stakeholders. However, as the risk assessment is conducted (in Stage 2) and management options identified (in Stage 3), other stakeholders could be invited to be a member of the committee where beneficial.

The Project Technical Committee

The project steering committee will receive advice from a *project technical committee*, consisting of a series of state government agencies, whose various roles and responsibilities across the study area are discussed in Section 3.3.2. The purpose of the technical committee would be to provide technical advice and information, as well as the provision of decision-making support for technical aspects of the project. As Stages 2 and 3 evolve, additional agencies may join the project technical committee if required.

Also providing advice will be a *traditional owner group* and a *community reference group*, consisting of representatives from particularly high-risk communities and the LHEMPC. The latter should be appointed by the steering committee and could use an EOI process to garner community interest.

In order to be successful, the CMP will need to ensure integration with the management initiatives and programs of the upper catchment areas, and establish channels for engagement with the councils and other stakeholders across the upper catchment. To this end, the councils operating across the wider Hawkesbury-Nepean catchment will form an *upper catchment committee* (if there is no existing platform), the purpose of which will be to support decision making through the provision of technical advice and information, and support linkages with management plans and strategies in action across the catchment. One avenue for establishing engagement could be through WaterNSW, who have developed relationships with the councils across the upper catchment (upstream of the dam walls) and may be able to assist in engaging with these councils. It should be noted that this committee could comprise representation from all eighteen (18) of the upper catchment councils. However, it may be more feasible for this committee to cover only the councils within the catchment below the declared Sydney catchment area. This would exclude Singleton, Lithgow, Cessnock and the Mid-Western Regional councils, which are quite remote - noting that activities in these LGAs are not recognised as a significant threat to the health of the catchment, estuary or coast in the downstream regions of the study area. A key role for the project coordinator during Stage 2 of the Study will be to establish suitable channels for engagement with the upper catchment committee and its associated members.

The use of *project sub-committees* (or project advisors) is recommended for major projects that occur within the CMP, particularly in Stage 5 where specific projects or tasks relating to management options will need to be scoped and implemented. The sub-committees would be 'sunset committees' i.e. once their task or project is successfully completed, they cease operation.

It is suggested that the agencies and organisations within the governance structure may be represented by more than one individual. Different individuals may represent their organisation for the CMP, and that representation for any given meeting or purpose may be determined based on technical requirements and availability.

A paid project coordinator is also recommended. In Stage 1, project management activities were shared by the Project Team and an officer from Hornsby Shire Council as an in-kind activity. However, with the increased diversity and intensity of project tasks (including community engagement) required in subsequent CMP stages, it is untenable to allow this shared role to apply without acknowledging the need for a part-time project coordinator role. It is suggested that the **project coordinator** be employed by a partner council on a 0.4 equivalent full time (EFT) basis during Stage 2 of the project. Given the scope of work involved with Stages 3 and 4 of the CMP, it is likely that the consultants undertaking the CMP project work would assume project coordination responsibilities during these stages. However, this should be reassessed at the conclusion to Stage 2 in order to ensure that that arrangement is appropriate moving forward. The job description of the project coordinator would include:

- Day-to-day project management of the CMP Stages 2.
- Communication between councils, agencies and other organisations in the governance structure;
- Managing budgets and financial transactions for the project;
- Reporting on financial and project progress;
- Preparing grant applications;
- Organising meetings e.g. progress meetings;
- Taking and distributing project meeting minutes;
- Organising events and other parts of the community and stakeholder engagement plan e.g. advertising community workshops, booking venues and catering;

- Liaising with partner councils regarding internal arrangements e.g. internal briefings for councillors, communications including media releases and social media;
- Monitoring the performance of the project and reporting this regularly to the project steering committee;
- Regular liaison with the consultant to monitor performance; and
- Responding to any enquiries about the project from stakeholders and communities.
- Updating common platforms used for CMP delivery; CMP communication; data sharing;

It should be acknowledged that as the CMP develops (e.g. risk analysis, management options), there should be flexibility in the composition of the project steering committee and the ability to add technical working groups and/or project sub-committees as required.

The suitability of the governance structure should be reviewed at least after each CMP stage and changes made if deemed appropriate by the project steering committee.

It should be noted that each Council will be responsible for the implementation of any actions specified by the CMP that is relevant to – or will benefit - its LGA. Furthermore, this Scoping Study endorses the right of any partner council to manage in their entirety any Stage 2 projects (outside of the proposed governance structure above) that are specific to its own LGA in order to streamline processes and utilise more efficiently the resources for project management. However, in doing so Councils should ensure that all projects relevant to the CMP are reported to the steering committee, and that they link and align with its goals and objectives. Individual project partners will be eligible to apply for funding from the NSW Coastal & Estuary Grants Program to complete projects identified in this scoping study (see Section 11.3).

TABLE 7-2 GOVERNANCE STRUCTURE SUMMARY

Governance Component	Responsibilities	Recommended Members
Project Steering Committee	▪ Oversight of CMP Delivery ▪ Decision making ▪ Appointment of community reference group members	▪ Central Coast Council ▪ Hawkesbury City Council ▪ The Hills Council ▪ DPIE ▪ Hornsby Shire Council ▪ Ku-ring-gai Council ▪ Northern Beaches Council
Project Coordinator	▪ Project Management of the CMP (Stage 2) on a day to day basis ▪ Further details provided above	As selected by the Project Steering Committee.
Project Technical Committee	▪ Provision of technical advice and decision-making support	▪ Project Steering Committee ▪ DPIE (Planning) ▪ DPIE (EES) ▪ DPIE (NPWS) ▪ DPIE (Crown Lands) ▪ DPIE (Fisheries) ▪ DPIE (EPA) ▪ DPIE (GSLLS) ▪ DPIE (NSW Food Authority) ▪ Water NSW ▪ Sydney Water ▪ TfNSW (Maritime) ▪ TfNSW (Sydney Trains) ▪ NSW SES; ▪ MEMA
Community Reference Group	▪ Provision of community perspective, technical advice and decision-making support ▪ Representation of community interests	As selected by the Project Steering Committee. A list of local community groups is provided in Section 4.3 for reference.
Traditional Owner Groups	▪ Provision of technical advice and decision-making support ▪ Representation of traditional owner interests	▪ Darkinjung LALC ▪ Metropolitan LALC ▪ Deerubbin LALC ▪ Other indigenous groups
Consultants	▪ Delivery of technical studies to support CMP	▪ To be determined by Steering Committee for each stage of the CMP
Upper Catchment Committee	▪ Provision of technical advice, data, and decision-making support ▪ Promote linkages with catchment related management plans and strategies	▪ Catchment Councils as listed in Table 3-8 ▪ INSW (HNFRMD) ▪ WaterNSW ▪ IPART
Project Sub-Committees	▪ Delivery and oversight of site/topic-specific projects delivered during Stage 5 of the CMP	▪ May comprise members of other technical committees and reference groups ▪ As appointed by the Project Steering Committee

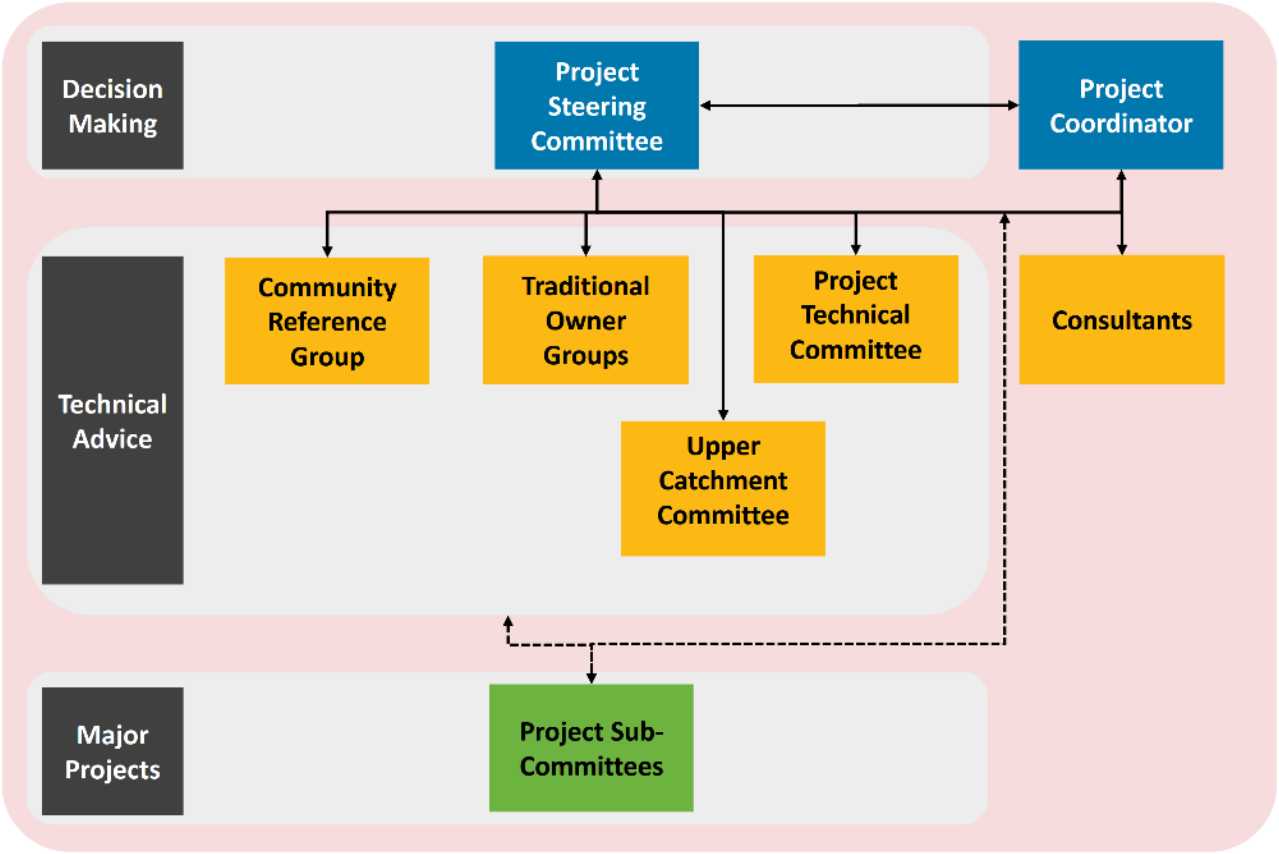


FIGURE 7-1 PROPOSED CMP GOVERNANCE STRUCTURE

8 FIRST-PASS RISK ASSESSMENT

8.1 Methods and Limitations

Section 21 (3) (b) of the CM Act requires the application of a risk management process when preparing CMPs and identifying where management actions are required (OEH, 2018a). To this end, a review has been undertaken to identify the environmental, social and economic values of the Hawkesbury-Nepean River system and its contributing catchment and to assess the various threats and pressures which may affect these values.

This has included the following components:

- A review of previous studies and existing information (see Appendix B);
- A review of historical community and stakeholder engagement activities undertaken across the study area (see Section 4.5);
- Consultation with key project stakeholders during the stakeholder engagement workshops undertaken as part of this study (see Section 4.6); and
- Application of expert technical input and local study area knowledge.

Subsequently, a high-level, first-pass qualitative risk assessment (FPRA) has been undertaken in accordance with the requirements set out in the NSW Coastal Management Manual. This assessment is essentially a tool for the prioritisation of risks, to identify those that need to be further assessed in subsequent stages of the CMP. It should be noted that this is intended as a broad based semi-qualitative assessment – and should be refined and developed in significantly greater detail during Stage 2 of the CMP.

8.2 Values

As discussed in Section 4.5, there have been a significant number of community and stakeholder engagement exercises undertaken across the study area over the last 15 years designed to ascertain community values and uses of the catchment, coastal zone and marine estate. These have been undertaken by all tiers of government to inform a range of different plans and strategies, spanning a wide range of geographical areas across the study area.

Notable state-wide and catchment-based engagement initiatives undertaken include the NSW Water Quality and River Flow Objectives (NSW Government, 1999), the Marine Estate Management Strategy (MEMA, 2018), and the Hawkesbury-Nepean Catchment Action Plan 2013-2023 (HNCMA, 2013).

The Hawkesbury-Nepean River system and its contributing catchment covers a vast geographical area that supports a significant diversity of social and cultural communities – each of which possess a unique set of values and ambitions. In order to identity these values and ambitions, a significant amount of community and stakeholder engagement has been undertaken by local councils as part of preparation of local coastal and estuary management plans.

Therefore, the review of estuary and catchment values in this Scoping Study has involved a two-step process:

- A review of high-level state and regional assessments of community uses and values; and
- Identification of local community uses and values through a review of locally based community engagement activities. As part of this study, the values have been mapped to the higher-level state goals and objectives in order to acknowledge the granularity and complexity of local values whilst maintaining consistency with high level assessments.

The values listed herein should be considered as a starting point that will be expanded upon during subsequent stages of the CMP.

As part of the Marine Estate Management Strategy (MEMA, 2018), around 1,700 NSW residents were surveyed regarding their values and attitudes in relation to the marine estate. The survey revealed that the NSW community considers the health of the marine estate as a core value. Diversity and abundance of marine life and natural beauty of the marine estate are key economic values for nature-based and regional tourism (MEMA, 2018). Overall, the MEMS survey found that the marine estate is integral to the social and cultural wellbeing of the community.

In undertaking the Hawkesbury-Nepean Catchment Action Plan 2013-2023 (HNCMA, 2013), consultation with communities in each landscape helped to identify key targets that reflect the values and priorities for the landscape. Catchment Action Plans have been developed in close consultation with local communities, shire councils and government agencies, using the latest scientific knowledge in order to improv river health.

A notable source of information on the environmental, social and economic values of the Hawkesbury-Nepean River system can be found in the NSW Water Quality and River Flow Objectives (NSW Government, 1999), which outline agreed community and environmental values and long-term goals for NSW's riverine waters. The objectives aim to:

- Set out the community's values and uses for the state's marine waters and waterways - including rivers, creeks, estuaries and lakes; and
- Provide a range of water quality indicators to assess the condition of the state's various waterways in relation to the community values and uses.

These objectives were developed by the state government (the then Department of Environment and Conservation) in consultation with the community and stakeholders such as local councils and state government organisations and are consistent with the national framework for assessing water quality (the ANZECC 2000 Guidelines). They provide an agreed framework to assess water quality in terms of whether the water is suitable for a range of environmental values, including human uses (DEC, 2005). The Water Quality Objectives Fresh and Estuarine surface waters (DEC, 2006) and Marine Water Quality Objectives (DEC, 2005) are provided in Table 8-1. It should be noted that these objectives are currently in the process of being reviewed by the state government as part of the MEMS process. Nevertheless, they provide an overarching vision of the high-level goals for the states riverine and marine waters.

It is worth noting that Northern Beaches Council and Hornsby Shire Council are working with DPIE in order to implement the NSW Based framework addressing community waterways values, as the framework links to the Marine Water Quality Objectives.

Local coast and estuary management plans (see Section 6.1) of the partner councils, and the community consultation activities they are informed by (see Section 4.5), offer information on a wide range of local community uses and values. These assessments generally provide significantly more granularity and detail, but the various community values can be grouped and categorised along the key lines of:

- Biodiversity & Natural Habitats;
- Water Quality;
- Social & Recreational Amenity;
- Scenic Amenity;
- Cultural Heritage;
- Economic Prosperity;

The various values given in these plans have been conceptually mapped to the NSW Water Quality and River Flow Objectives in order to establish linkages and to compare and contrast the values reported in the different zones of the estuary. These linkages are provided in Table 8-1, and are broken down into key estuary areas including the Upper Hawkesbury (UH), the Lower Hawkesbury (LH), Brisbane Water (BW), Pittwater (PW) and

Broken Bay Beaches (BB). During the course of this exercise, a number of additional values (other than those listed in Table 8-1) were consistently reported across the study area, and an overview of these is provided in Table 8-2.

In addition to the Water Quality Objectives listed in Table 8-1, a series of River Flow Objectives have been determined (NSW Government, 1999). Whilst these are less applicable to the tidal waterways of the estuary, they are relevant higher in the catchment, and for this reason have been listed below for consideration in the CMP:

- Protect pools in dry times
- Protect natural low flows
- Protect important rises in water levels
- Maintain wetland and floodplain inundation
- Mimic natural drying in temporary waterways
- Maintain natural flow variability
- Maintain natural rates of change in water levels
- Manage groundwater for ecosystems
- Minimise effects of weirs and other structures
- Minimise effects of dams on water quality
- Make water available for unforeseen events
- Maintain or rehabilitate estuarine processes and habitats

TABLE 8-1 NSW RIVER AND MARINE WATER QUALITY OBJECTIVES COMMUNITY AND ENVIRONMENTAL VALUES AND USES (NSW GOVERNMENT, 1999), AND APPLICATION TO HAWKESBURY-NEPEAN RIVER SYSTEM

Category	Community and Environmental Value	Icon	Description, as per NSW Government (1999)	UH	LH	BW	PW	BB
Environmental	Aquatic ecosystems		Maintaining or improving the ecological condition of waterbodies and their riparian zones over the long term	✓	✓	✓	✓	✓
Social and Cultural	Visual amenity		Aesthetic qualities of waters and maintaining the natural character of the waterway	✓	✓	✓	✓	✓
Social and Cultural	Primary contact recreation		Maintaining or improving water quality for activities such as swimming or surfing in which there is a high probability of water being swallowed	✓	✓	✓	✓	✓
Social and Cultural	Secondary contact recreation		Maintaining or improving water quality for activities such as boating and wading, where there is a low probability of water being swallowed	✓	✓	✓	✓	✓
Social and Cultural / Economic	Aquatic foods (cooked)		Refers to protecting water quality so that it is suitable for the production of aquatic foods for human consumption and aquaculture activities.	✓	✓	✓		✓
Social and Cultural	Homestead water supply		Protecting water quality for domestic use in homesteads, including drinking, cooking and bathing	✓	✓	✓		
Social and Cultural / Economic	Livestock water supply		Protecting water quality to maximise the production of healthy livestock	✓	✓	✓		
Social and Cultural / Economic	Irrigation water supply		Protecting the quality of waters applied to crops and pasture	✓				
Social and Cultural / Economic	Drinking water at point of supply		Refers to the quality of drinking water drawn from the raw surface and groundwater sources before any treatment	✓		✓		

TABLE 8-2 ADDITIONAL ESTUARY AND CATCHMENT VALUES

Category	Community and Environmental Use	Rationale	UH	LH	BW	PW	BB
Social and Cultural	Cultural Heritage	The catchment and coastal zone are a central part of the Hawkesbury's heritage and culture. The region has a rich and continuing Aboriginal heritage, and the coastal zone has high cultural and spiritual significance to significant to its Traditional Owners. The study area also includes areas and items of non-indigenous heritage significance. Cultural and spiritual values are also recognised as a key community value in the ANZ Guidelines for Fresh and Marine Water Quality.	✓	✓	✓	✓	✓
Social and Cultural	Economic Prosperity	The estuaries of the study area and their catchments are a significant economic resource that support a wide range of industries. The coastal zone provides direct economic value through industries which are dependent on the ecosystem services provided by coastal environments such as aquaculture, commercial fishing and tourism. It also has a high level of indirect economic value, associated with the knowledge that there is a healthy and sustainable environment and ecosystems. It is a major contributor to the local and regional economy.	✓	✓	✓	✓	✓

8.3 Threats and Stressors

Threats to community uses and values arise from a range of stressors, and can have impacts on the environmental, social and economic values of the study area. The various threats and stressors associated with the Hawkesbury-Nepean River system and its comprising estuaries have been identified through stakeholder engagement (see Section 4.6), a review of previous coastal and estuary studies and management plans (see Section 6.1), and the Marine Estate Management Strategy Threat and Risk Assessment (BMT WBM, 2017).

Based on this preliminary review, a total of 67 stressors has been initially identified, across five (5) threat categories. A brief overview of the various study area threats is provided in Table 8-3, which also provides an outline of the potential environmental and socioeconomic impacts of these threats.

TABLE 8-3 SUMMARY OF THREATS

Threat	Stressor Category	Stressor (and Stressor ID)	Environmental Impacts	Social and Economic Impacts
Coastal and Estuarine Hazards	**Long Term Hazards**	1.1 Tidal inundation of estuaries (i.e. "sunny day flooding") 1.2 Estuary foreshore erosion and bank instability 1.3 Long term coastal shoreline recession 1.4 Estuary entrance instability 1.5 Cliff and slope instability	▪ Shoreline and bank erosion can affect foreshore biodiversity ▪ Rising sea levels generate "habitat squeeze" ▪ Bank erosion can cause increased sedimentation of the waterway and affect benthic/riparian habitat ▪ Sand movement changing navigational channels and water flow/circulation	▪ Inundation of low-lying foreshores during king tide events can affect social and recreational amenity ▪ Ingress of tidal inundation to low lying communities can affect access and public safety and threaten assets and infrastructure ▪ Long term shoreline recession and estuary bank erosion can affect recreational and social amenity through reduction of open space ▪ Long term shoreline recession and estuary bank erosion can threaten and undermine foreshore assets and recreational access ▪ Cliff instability can threaten foreshore assets and public safety
	Event Based Hazards	2.1 Coastal storm impacts - erosion 2.2 Coastal storm impacts - inundation 2.3 Combined coastal and catchment flooding 2.4 Bushfire 2.5 Drought 2.6 Tsunami 2.7 Dam breach / break	▪ Catchment flooding can transport pollutants into the river system ▪ Bushfire may result in loss of habitat and biodiversity in the short to medium ▪ Coastal erosion may result in loss of dune habitat, and seabed deposition can affect seagrass and benthic habitat and biodiversity in the short term ▪ Droughts can affect salinity in the upper catchment, environmental flow in urban creeks, loss of macroinvertebrates and riparian vegetation that requires freshwater ▪ Run-off, erosion and biodiversity impacts of bushfire events	▪ Coastal erosion and inundation during storm events are a threat to foreshore assets on private and public land, foreshore access, and social and recreational amenity values ▪ Catchment flooding affects low lying infrastructure and environmental assets, and represents a significant risk to public safety ▪ Bushfires represent a huge public safety risk and can affect recreational amenity values ▪ Tsunami, whilst rare, can significantly affect maritime assets and infrastructure and low-lying land, and represent a serious risk to public safety ▪ Drought/ Dry creeks have impacts on social and recreational amenity values (fishing, walking/hiking)
	Climate Change Impacts	3.1 Altered ocean currents and nutrient inputs 3.2 Ocean temperature increase 3.3 Ocean acidification 3.4 Altered storm frequency and severity 3.5 Altered hydrological regimes 3.6 Sea level rise 3.7 Long term shoreline recession due to sea level rise 3.8 Altered salinity levels / profile 3.9 Habitat migration and squeeze	▪ Increased ocean temperatures and ocean acidification are expected to have a negative impact on ecological health (increased occurrence of algal blooms) and biodiversity of the river system - e g increased number of jellyfish, introduction of aquatic/marine pest species (bryozoans like Amathia verticillate) and diseases (POMS etc) ▪ Sea level rise and rainfall impacts will affect coastal and estuarine processes and dynamics – including erosion ▪ Increased flood severity may negatively impact water quality on terrestrial (riparian), aquatic and marine coastal ecosystems ▪ Altered rainfall regimes may affect the baseline hydrology of the upper catchment and overall primary productivity ▪ Landward migration of coastal wetlands will occur in response to sea level rise. However, coastal development will form a barrier to wetland migration in some areas, resulting in habitat squeeze ▪ Salinisation of groundwater habitats and impact on groundwater dependent ecosystems ▪ Changes in the distribution of biodiversity, in particularly pest species such as Cane Toads	▪ Sea level rise is likely to significantly affect low lying coastal communities in terms of their susceptibility to tidal inundation, coastal inundation and catchment flooding ▪ Increases in heavy rainfall events are expected to increase the likelihood of flooding along the upper catchment, with impacts on private property, loss of crops and livestock, increased frequency of oyster harvest area closures etc ▪ Increased frequency and severity of storm and erosion events will result in economic costs as well as implications for socialisation and sense of community ▪ Climate change impacts on marine and estuarine ecology will affect specific businesses and industries (such as aquaculture and commercial fishing) and recreational use of the river system ▪ Climate change stressors such as sea level rise and increased sea temperatures can negatively impact cultural heritage ▪ Salinisation of groundwater resources and impact on agricultural activity
Urbanisation and Land Use Impacts	**Water Pollution and Sediment Contamination**	4.1 Urban stormwater discharge 4.2 Agricultural runoff 4.3 Industrial discharges 4.4 Sewage effluent and septic runoff 4.5 Sediment contamination / pollution 4.6 Disturbance of contaminated sediment on seabed (e.g. dredging) and in foreshore areas	▪ Water pollution – through nutrients and organic matter, toxic contaminants, sediments, pathogens and marine debris ▪ Contribution to proliferation of algal blooms and aquatic weeds ▪ Impacts on aquatic ecology ▪ Bank erosion along creeks and rivers due to increased effective imperviousness and associated water velocity	▪ Water pollution due to stormwater and sewer discharge, agricultural runoff and industrial discharges can impact health, safety and wellbeing ▪ Loss of amenity associated with pollution likely to significantly impact people's relationship with the coast and their ability to appreciate marine biodiversity ▪ Impacts on seafood quality (aquaculture and commercial fishing) on health, safety and wellbeing ▪ Local Businesses that are dependent on the coastal zone for their viability, such as aquaculture, commercial fishers and tourist operators, may experience major impacts on viability due to events such as closures and fish kills

Threat	Stressor Category	Stressor (and Stressor ID)	Environmental Impacts	Social and Economic Impacts
				▪ Water pollution can impact on tangible Aboriginal cultural heritage including damage to places of significance ▪ Sediment contamination and pollution may restrict viability of waterway dependant businesses including aquaculture
	Habitat Disturbance	5.1 Foreshore / urban development 5.2 Stock grazing of riparian and marine vegetation (in estuaries) 5.3 Clearing / disturbance of riparian and aquatic habitat 5.4 Clearing / disturbance of littoral rainforest habitat 5.5 Clearing / disturbance of terrestrial habitat 5.6 Introduction of invasive fauna pest species (e.g. carp) and diseases (POMS etc) 5.7 Introduction of invasive flora pest species (e.g. aquatic weeds) and diseases	▪ Physical disturbance resulting from shoreline infrastructure, sediment re-suspension and shading resulting in light limitation, sediment deposition ▪ Wildlife disturbance through pollution and habitat loss ▪ Introduction of pest species can have negative impact on habitats and protected species ▪ Changes to river flow velocity and patterns ▪ Threats to species of conservation significance and overall biodiversity of the coast zone ▪ Clearing terrestrial vegetation results in increased runoff of sediment into the upper estuary	▪ Environmental impacts may reduce recreational amenity and social enjoyment of environmental values ▪ Impacts on people's relationship with the coast (e.g. loss of appeal due to decline in wildlife and depreciation of visual character) will also impact social connections ▪ Habitat (physical disturbance) from human activity can impact on Aboriginal cultural heritage
	Hydrologic Modifications	6.1 Increasing use of groundwater 6.2 Modified freshwater flows, including water extraction WWTP discharges 6.3 Sedimentation and infilling channels and changing and regulating flows 6.4 Navigation and entrance management and modification (such as dredging)	▪ Natural hydrology altered through unsustainable surface and groundwater extraction ▪ Changes to hydrological regime can result affect habitat and biodiversity in the upper estuary ▪ Dredging can result in physical disturbance and habitat loss resulting from sediment re-suspension and turbidity etc ▪ Water pollution & contamination through disturbance of acid sulfate soils ▪ Sedimentation impacts on seagrass ▪ Dredging can modify tidal flow and tidal prism within estuaries	▪ Sedimentation can affect navigation channels, negatively affecting recreational and commercial use of the waterways ▪ Turbidity associated with dredging can negatively affect recreational amenity ▪ Modified freshwater flows can impacts commercial and recreational fishing, and Aboriginal cultural heritage, by negatively affecting fish stocks
Waterway Use and Resource Conflict	**Commercial Fishing and Boating**	7.1 Commercial fishing in coastal / marine waters - ocean haul etc 7.2 Commercial fishing in estuaries - prawn trawl etc 7.3 Aquaculture – oyster farming etc 7.4 Commercial boating - small commercial vessels and charters activities etc	▪ Water quality – toxic contaminants through antifouling paint and oil spills, sediment resuspension, and effluent disposal ▪ Reductions in abundances of species and trophic levels ▪ Boat wash induced bank erosion (including resultant loss of foreshore biodiversity) ▪ Bycatch (including incidental catch of species of conservation significance) ▪ Physical disturbance (e.g. seagrass) through anchor damage ▪ Wildlife disturbance (shorebirds, turtles, wales) ▪ Impacts of oyster aquaculture include seabed shading from oyster racks and habitat clearance ▪ Introduction of marine pest species through ballast waters and through movement of boats across waterbodies (i.e. Caulerpa)	▪ Environmental impacts may reduce recreational and social amenity and enjoyment of environmental values ▪ Overfishing, or the localised depletion of fish stocks, may contribute to measurable and ongoing negative economic impacts for the commercial/recreational fishing industry ▪ Bank erosion is a threat to the built foreshore assets, access and amenity value on private and public land
	Recreation and Tourism	8.1 Recreational fishing (boat and shore based) 8.2 Recreational boating and boating infrastructure 8.3 Passive Recreational Use 8.4 Coastal infrastructure, marina expansion, modifications, upgrades and associated dredging. 8.5 Anti-social behaviour and unsafe practices	▪ Water pollution – contaminants released into the waterway through antifouling paint and oil spills, and effluent disposal ▪ Boat wash generating bank erosion (including resultant loss of foreshore biodiversity) ▪ Physical disturbance (i.e. seagrass) resulting from propeller wash, anchoring, moorings, and shoreline infrastructure ▪ Shading from boats/jetties resulting in light reduction to the seabed – and associated impacts on benthic communities ▪ Disturbance of fauna through noise and vessel strike ▪ Dredging can generate elevated turbidity that can affect benthic communities	▪ Environmental impacts may reduce recreational and social amenity ▪ Recreational pressures on the river system may impact amenity and therefore people's enjoyment and relationship with the estuary environmental values ▪ Increased in number and size of boats creating larger boat wash and impacting on navigational safety
	Access and Availability	9.1 Overcrowding / congestion of waterways and user group conflict 9.2 Overcrowding / congestion of foreshores/beaches and user group conflict 9.3 Limited or lack of foreshore and waterway access 9.4 Limited or lack of supporting infrastructure (for boating etc)	▪ Overcrowding of river foreshores can result in disturbance of riparian and adjacent habitat ▪ Disturbance of fauna through noise and vessel strike	▪ Overcrowding / congestion reduces the recreational and social amenity of the river system, resulting in "loss of appeal" ▪ Tangible and intangible Aboriginal cultural heritage is impacted by conflict over resource access and use ▪ Continued and ongoing incidents of anti-social behaviour are likely to deter community use of the marine estate

Threat	Stressor Category	Stressor (and Stressor ID)	Environmental Impacts	Social and Economic Impacts
		9.5 Lack of disability access		▪ Increased number of seaplanes using waterways potentially conflicting with current activities but promoting tourism
Public Health and Safety	**Public Health and Safety**	10.1 Water pollution/contamination affecting human health and safety – including algal blooms 10.2 Seafood contamination 10.3 Drinking water contamination 10.4 Coastal hazards (coastal erosion, cliff instability and inundation/wave overtopping) 10.5 Public safety risk from aging and/or degraded coastal/estuary infrastructure 10.6 Wildlife interactions (sharks, jellyfish etc)	N/A	▪ Seafood contamination can have major impacts on public health, and threaten the viability of fishing and aquaculture industries ▪ Wave overtopping of coastal structures can represent a safety hazard to the general public ▪ Energetic coastal processes represent a significant safety risk to local users, particularly in the form of rip currents ▪ Shark attacks can threaten life and safety. Media and news coverage can have a negative impact on recreational use of the study area
Planning and Governance	**Governance**	11.1 Lack of adequate coordination between estuary councils, catchment councils and state government agencies – and jurisdictional ambiguity. 11.2 Inadequate, inefficient regulation, or over-regulation (agencies) 11.3 Lack of compliance with regulations (by users) or lack of regulation effort (by agencies) 11.4 Lack of funding for investigation and action implementation 11.5 Lack of or ineffective community engagement or participation in governance	▪ Creation of unauthorised private boat ramps and jetties can all affect foreshore habitat and biodiversity ▪ Inadequate regulations and enforcement for protection can affect threatened and significant species	▪ Lack of regulation and compliance has the potential to create long-term negative impacts on businesses and employment. Commercial fishers may also be significantly impacted where their livelihoods are under threat from overfishing and habitat destruction related to illegal activities ▪ The roles and responsibilities of the various agencies across the estuary and catchment create inefficiencies with regards to management and approvals processes ▪ Environmental impacts may reduce recreational and social amenity and enjoyment of environmental values
	Information Gaps	12.1 Incomplete coastal and estuary process information (including climate change impacts or hydrodynamics along the entire river system) 12.2 Incomplete ecological information (including climate change impacts) 12.3 Inadequate and/or incomplete European and Indigenous Heritage information 12.4 Inadequate social and economic information	▪ Lack of adequate information hampers the implementation of effective management strategies and plans	▪ The cumulative impacts of socio-economic threats are an area that has received limited research attention to date, and this is recognised as a current data gap in the TARA process ▪ There is a knowledge gap around the views and aspirations of Aboriginal people in regard to the NSW marine estate, and this may affect the cultural and heritage amenity of the area

8.4 First Pass Risk Assessment

The risk assessment has been undertaken for the list of threats potentially affecting the environmental, social and economic values of the study area. The assessment has been undertaken in a systemic fashion, in accordance with the following national risk standards and guidelines:

- ISO 31000:2018, Risk management – Principles and guidelines, provides principles, framework and a process for managing risk and
- AS 5334:2013 Climate change adaptation for settlements and infrastructure – a risk-based approach.

The assessment process was systematic and involved the application of qualitative scales of likelihood and consequence. The scales of likelihood and consequence adopted for this assessment have been modified from the MEMA TARA (BMT WBM, 2017) in order to provide consistency with that wider assessment.

TABLE 8-4 CONSEQUENCE DEFINITIONS, ADAPTED FROM MEMA TARA (BMT WBM, 2017)

Consequence	Definition
Insignificant	No or barely discernible negative impacts on the environmental, social or economic values
Minor	Discernible and/or temporary negative impacts on the environmental, social or economic values
Moderate	Measurable and/or on-going negative impacts on the environmental, social or economic values
Major	Substantial measurable and/or ongoing negative impacts on the environmental, social or economic values
Catastrophic	Significant on-going and/or permanent negative impacts on the environmental, social or economic values, and where these values are endangered either permanently or irreversibly

TABLE 8-5 LIKELIHOOD DEFINITIONS, ADAPTED FROM MEMA TARA (BMT WBM, 2017)

Likelihood	Definition
Rare	Never reported for this situation, but still plausible within the timeframe (< 5%)
Unlikely	Uncommon, but has been known to occur elsewhere. Expected to occur here 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%)

Based on the delineation of likelihood and consequence, a risk rating has been provided based on the risk matrix in Table 8-6, which is again consistent with the MEMA TARA (BMT WBM, 2017). The risk ratings are based on a range of technical inputs listed in Section 8.1, including the expert judgement applied by the project stakeholders during the first Stakeholder Engagement Workshop (Section 4.6).

It is acknowledged in this scoping study that the Hawkesbury-Nepean River system (including Brisbane Water, Pittwater, and Broken Bay) and its contributing catchment cover a significant geographic region, and that the various threats and stressors are not uniformly distributed across the study area. The first pass-risk assessment provided herein is intended as a broad, first-pass screening to identify the direction and scope of

future CMP stages, and is not intended to possess the granularity of a detailed, site-specific analysis which is to be undertaken during Stage 2.

Therefore, this first pass risk assessment has an element of subjectivity when considering the overall level of risk when a threat(s) may be relatively localised in nature. Subsequently, the assessment has applied a conservative or worst-case approach, and where a threat may be considered as high risk even for a relatively localised area, it has been given a rating of high risk overall, in order to clearly identify the issues and provide direction and clarity for the remaining CMP stages. This approach has been adopted as the FPRA is intended as an initial screening to identify the need for further studies.

TABLE 8-6 RISK ASSESSMENT MATRIX, ADAPTED FROM MEMA TARA (BMT WBM, 2017)

Consequence → / Likelihood ↓	Insignificant	Minor	Moderate	Major	Catastrophic
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

For each of the assessed threats, the risk assessment has considered the following factors:

- What are the existing arrangements to address the threat? Specific attention has been paid to where these threats have been addressed by the previous coastal and estuary management plans identified in Section 6.1, but where threats are addressed by other plans and strategies (such as state-base), they have also been identified.
- Are the existing arrangements working? If so, what is the residual risk? A residual risk rating has been provided.
- How will the risk level change over future planning horizons of 20, 50 and 100 years? Particular consideration was given to the degree of future risk with the impacts of population and development pressures and climate change.

The results of the first-pass risk assessment are provided in full in Appendix F. High-risk threats and key issues identified by the assessment are discussed in Section 8.5.

8.5 Key Issues

The purpose of this section is to identify and briefly outline the key issues affecting the study area – including existing issues and future emerging issues likely to affect the study area over defined management timeframes. The risk assessment identified 20 high risk stressors which presently affect the study area. A brief snapshot of these stressors is provided in Table 8-7. A key component of this study was also to identify emerging and future stressors to the study area. These are outlined in Table 8-8.

Based on the nature and the scope of the issues identified below, the Coastal Management areas discussed in Section 5, and mapped in Figure 5-1and Figure 5-2, are considered to be suitable to address the various threats and stressors to the environmental, social and economic values of the study area. This is particularly the case of high priority issues such as coastal hazards (inducing tidal inundation and bank erosion) and water quality, sedimentation and erosion and at-risk public infrastructure.

TABLE 8-7 PRESENT DAY HISH RISK THREATS AND KEY ISSUES

ID	Threat	Issue Overview
Natural Hazards		
1.1	**Tidal inundation of estuaries (i.e. "sunny day flooding")**	There are a number of hotspots across the study area that are exposed to tidal inundation (i.e. "sunny day flooding"). OEH (2018c) lists Brisbane Water as the third most vulnerable estuary system in the state, with over 200 properties exposed to tidal inundation for present day sea levels, increasing to around 2,000 properties with 0.5 m of SLR, and over 4,000 properties with 1.0 m of SLR. Areas that are severely affected by coastal inundation include Empire Bay, Davistown, Saratoga, St Huberts Island, Woy Woy, Kincumber, and Green Point. Tidal inundation also periodically affects riverside settlements across the Lower Hawkesbury including Dangar Island, Milsons Passage and those long Berowra Creek (BMT WBM, 2008) and various hotspot within Pittwater including Scotland Island (Cardno 2015). Inspection of OEH (2018c) mapping also identified potential tidal inundation impacts to critical infrastructure, including the Sydney-Newcastle railway line at the Mullet Creek tributary. For many areas adjacent to these estuaries, the OEH (2018c) mapping indicates that there will be limited room for the upslope migration of macrophytes where the estuary foreshore abuts areas of residential development.
1.2	**Estuary foreshore erosion and bank erosion**	Bank erosion is a significant issue throughout the study area's tidal waterways - and is associated with a number of causes such as wind waves, boat wash, uncontrolled stock grazing and lack of riparian vegetation. This bank erosion has been identified by a number of estuary process studies and bespoke assessments across the Upper Hawkesbury, Lower Hawkesbury, Brisbane Water and Pittwater - see Section 5.2.4.
1.4	**Coastal erosion**	Storm induced coastal erosion occurs periodically and is associated with energetic offshore wave conditions and elevated tides that occur during low-pressure systems such as east coast lows. The exposed beaches of Broken Bay are the most at risk of severe storm erosion, including Patonga Beach, Pearl Beach and Ocean/Umina Beach, which are backed by residential properties and public infrastructure. Periodic (event based) erosion has also been observed at Dangar Beach. "Beach erosion caused by storms is also known to occur in Pittwater. For example, Sand Point Beach, Paradise Beach and Great Mackerel Beach.
2.2	**Coastal inundation**	There are a number of communities around the various foreshores of the study area that are affected by storm related coastal inundation – to various levels of severity and risk. Investigation of mapping undertaken across the various local studies (see Section 5.2.4) and state-wide inundation mapping OEH (2018c) indicates that there are a number of these communities across the Lower Hawkesbury, Pittwater and Brisbane Water. A number of highly developed areas of Brisbane Water are severely affected by coastal inundation including Empire Bay, Davistown, Saratoga, St Huberts Island and Woy Woy. Across the Lower Hawkesbury, areas affected by coastal inundation include Patonga, Brooklyn, Dangar Island, Mooney Mooney, and Berowra Waters. These present-day coastal inundation threats will be exacerbated with future SLR impacts.

ID	Threat	Issue Overview
2.3	**Combined coastal and catchment flooding**	The joint occurrence of coastal and catchment flooding is considered minimal across the Upper Hawkesbury, given the response time of the catchment and the fact that flood peaks reach estuarine reaches of the Hawkesbury-Nepean several days after storm activity (WMA, 2018). However, the upper reaches of the Brisbane Water Estuary are affected by catchment flooding and specifically the joint occurrence of catchment and coastal flooding. These locations include (but are not limited to) Fagans Bay and Narara Creek, Erina Creek, Kincumber Creek, and the Woy Woy Inlet.
2.4	**Bushfires**	Bushfires remain an ever-present risk across the vast expanse of national park and adjacent urban fringe across the study area. This is mostly managed though Local Government Bushfire Risk Management Plans, the NSW RFS and Fire and Rescue NSW, and the NPWS. The CMP should seek linkages with these existing plans and managing authorities.
Land Use Intensification & Environmental Impacts		
4.1	**Urban stormwater discharge**	Catchment runoff and urban stormwater discharge are a major source of water quality issues at various locations across the study area. This discharge often contains a range of pollutants including sediment, nutrients, heavy metals, hydrocarbons, chemical compounds and gross pollutants. Areas with less tidal flushing are more likely to experience degradation, particularly where catchment inputs are high in pollutants. Hotspots across the Upper Hawkesbury include the South Creek and Cattai Creek confluences, and generally water quality is lower between Windsor and Sackville (BMT WBM, 2013a). Across the Lower Hawkesbury, the effects of this threat are worse in tributary creeks which have less frequent tidal flushing, particularly in upper Berowra Creek (BMT WBM, 2008). Across Brisbane Water, hotspots include the Narara, Erina Creek and Kincumber Creek catchments (CLT, 2012).
4.2	**Agricultural runoff**	Runoff from the wider catchment contains nutrients and sediments typically associated with agricultural activities, as well as fertiliser and chemicals such as hydrocarbons and pesticides. Agricultural runoff across the study area is known to be high in turbidity, oxidised nitrogen, TN and ammonia (BMT WBM, 2013a; BMT WBM, 2008). Intensive agricultural areas contribute high nutrient loads the reach of the Hawkesbury River in between Windsor and Lower, particularly during wet weather. Discharges from tributaries such as South Creek and Currency Creek are the main source of nutrients, with land uses widely varied but reflective of significant nitrogen and phosphorus loads (BMT WBM, 2013a). This also contributes to algal proliferation.
4.4	**Sewage effluent & septic runoff**	There are over 40 WWTPs that discharge to the Hawkesbury River estuary (BMT WBM, 2013a). These discharges contain increased nutrient loads which contributes to the proliferation of algae blooms/aquatic weeds across the Upper Hawkesbury Estuary. WWTP discharges and sewer overflows may also contain faecal pollutants. In particular, major sewage inputs into the system arrive via South Creek, however discharges at West Hornsby WWTP and Hornsby Heights WWTP have historically resulted in water quality issues in Berowra Creek (BMT WBM, 2008). Many foreshore and rural properties are not connected to reticulated sewage systems and operate on-site treatment systems. The performance of these systems is variable across many locations across the catchment, with many systems not designed for the usage applied (e.g. holiday rental scenarios).

ID	Threat	Issue Overview
		Additionally, pollutants entering waterways from marinas and yacht clubs, and water-based emissions from boats (such as contaminated bilge water) result in negative impacts across Brisbane Water, and in particular Pittwater (Rhelm, 2018).
4.5	**Sediment contamination**	Across the Lower Hawkesbury, Pittwater and Brisbane Water, sediment contamination issues are generally found in close proximity to recreational boating hubs such as marinas, boat servicing/cleaning areas and slipways, and moored vessels using anti-fouling paint, and contain elevated concentrations of arsenic, tributyltin, lead, zinc, copper, chromium and mercury (CMGGEC, 1998; L&T, 2003). Brisbane Water sediment contamination is also associated with industrial discharges and urban runoff from Erina and Narara Creeks. Across the Upper Hawkesbury, particularly between Windsor and Cattai, sediment contamination issues largely stems from urban stormwater discharge and agricultural runoff.
5.2	**Stock related damage of riparian and marine vegetation**	Stock access is apparent in various locations throughout the upper Hawkesbury, as identified in the Upper Hawkesbury CZMP (BMT WBM, 2013a). Isolated issues are also apparent in other locations including Mangrove Creek and Glenworth Valley. Stock access to the riparian vegetation contributes to bank erosion and affects water quality through increased sedimentation and nutrient loading.
5.3	**Clearing / disturbance of riparian and aquatic habitat**	The Upper Hawkesbury CZMP (BMT WBM, 2014) outlines disturbance and clearing of riparian habitat, and lack of appropriate riparian vegetation as a key issue. This disturbance is associated with illegal vegetation clearing by landowners, ad hoc bank works, stock access to banks, and encroachment of private development onto public land. Across the Lower Hawkesbury, agricultural and urban land uses have resulted in the clearing of terrestrial habitat and the removal/degradation of riparian vegetation (WBM, 2006b; WRL, 2003). Across Pittwater and Brisbane Water, disturbance to seagrass beds by moorings and foreshore development have historically resulted in impacts to aquatic ecosystems (BMT WBM, 2010). In particular Erina and Narara Creeks have experienced substantial impacts to riparian vegetation in middle and upper reaches.
5.5	**Sedimentation & infilling channels and changing and regulating flows**	Within Brisbane Water, there is evidence of long-term sedimentation due to catchment derived sediments at a number of inlets and embayments including Mud Flat Creek and Hardy's Bay (CLT, 2009). Across Pittwater, catchment runoff has caused exacerbated siltation at many locations such as Browns Bay, Winnererremy Bay, Crystal Bay, Salt Pan Cove, Careel Bay and Scotland Island. The Lower Hawkesbury has experienced historical siltation and sedimentation around the Sandbrook Inlet, the upper reaches of Berowra Creek, Brooklyn Harbour, and a number of navigation channels. Across, Pittwater, shoaling of marine sediments is occurring at some locations including The Basin and Bayview (Rhelm, 2018). The multitude of dams and weirs across the Hawkesbury-Nepean River system generate a significant effect on environmental flows with resultant impacts to water quality and geomorphology, as well as ecological impacts such as restrictions of fish passage between freshwater and estuarine habitats. The raising of Warragamba Dam and associated impacts on flows released to the estuary during flooding conditions may also represent a threat to local aquatic ecosystems.

ID	Threat	Issue Overview
5.6	**Introduction of invasive fauna pest species and diseases**	Oyster Production across the Hawkesbury in recent years has been affected by the effects of Pacific Oyster Mortality Syndrome (POMS) disease events, and effects of QX disease (DPI, 2016). These outbreaks significantly affect aquaculture production - see Section 3.6.1. Additionally, existing issues exist with regards to feral/wild Pacific oysters colonising the foreshore and maritime infrastructure. Pests such as carp and other introduced fish species have historically been an issue across the Upper Hawkesbury. Across the national parks of the study area, pest species include cats, dogs, foxes, European honey-bees and rabbits (BMT WBM, 2008; NPWS, 2002).
5.7	**Introduction of invasive flora pest species and diseases**	Weeds are most prevalent along foreshores of the Hawkesbury at various locations along the river and its tributaries. The aquatic weed *Egeria densa* proliferates much of the foreshore of the Upper Hawkesbury, whilst the estuarine portion of the Lower Hawkesbury River and Pittwater are noted to contain the noxious macroalgae *Caulerpa taxifolia* and other aquatic weeds such as *Juncus acutus* (BMT WBM, 2008).
Public Health and Safety		
10.1	**Water pollution/ contamination affecting human health and safety**	Water pollution/contamination can arise from a number of sources, including urban stormwater discharge, agricultural runoff and sewage effluent & septic runoff and discharge from vessels and river settlements on a waterway. These pollutants can affect human health and safety for those coming into contact through primary and secondary recreation, particularly in upstream locations during and following period of heavily rainfall, and these issues have been reports across numerous sites across the entire study area. Additionally, the presence of algal blooms can be detrimental public health through primary and recreational contact (see Stressor ID 8.8).  **FIGURE 8-1 ALGAL BLOOM IN BEROWRA CREEK IN 2016 (SOURCE: DAILY TELEGRAPH)** Across the Hawkesbury, prolonged low flows (due to river regulation) combined with increased nutrient inputs due to agricultural and industrial discharges interact together to give favourable conditions for the development of blue-green algal blooms (Krogh et al 2009; BMT WBM, 2013a). Blooms of harmful algal species have been periodically observed across the upper estuary, as well as the lower estuary in locations such as Wisemans Ferry,

ID	Threat	Issue Overview
		Berowra Creek (see Figure 8-1) and Marramarra Creek (Ajani et al, 2016; Farrel et al, 2013). These blooms are detrimental to oyster aquaculture and commercial fishing (BMT WBM, 2008), but also may represent a risk to public health through primary and recreational contact, and seafood contamination. Furthermore, these blooms also pose a significant risk to local flora and fauna through release of toxins and depletion of oxygen in the water column as they decay. Additional issues exist such as the poly-fluroalkyl substances (PFAS) contamination on and around Richmond RAAF Base. PFAS contamination may affect soil, groundwater, surface water, drinking water, sediment, terrestrial biota and finfish (AECOM, 2018). This may affect human health, and AECOM (2018) identified that recreational users of publicly accessible surface water including the Hawkesbury River and tributaries may be affected. This is currently monitored by the Department of Defence. Historic land fill sites across the study area also act as a possible contamination source.
10.2	**Seafood contamination**	Contamination of seafood can arise from a number of sources. Historically the oyster industry of the Lower Hawkesbury has been affected by blooms of harmful algae species (see Stressor ID 10.1) such as *Alexandrium catenella*, which is known to produce Paralytic Shellfish Poisoning (PSP) toxins and affect the consumption of locally grown oysters (DPI, 2016). PFAS contamination emanating from the Richmond RAAF Base may also result in seafood contamination impacts – though none have yet been reported.
10.5	**Degraded/ failing coastal infrastructure**	The study has also identified that a public safety issue across the study area is the condition of the Hawkesbury River Railway Bridge. Much has been investigated and publicly reported about the condition of the Bridge in recent years. Underwater inspections of the bridge are undertaken every six years as part of Sydney Trains bridge management program. Condition assessment inspections of the bridge by SMEC (2016) identified that Sydney Trains should proceed with a repair and strengthening regime for the bridge. Additionally, there also exists a number of degraded coastal/foreshore protection structures across Brisbane Water. Central Coast Council currently have a prioritisation process for upgrading this infrastructure.
Planning & Governance		
11.1	**Lack of adequate governance coordination**	As discussed in Section 6.4, the lack of coordination across the river system between estuary councils, catchment councils, and state government agencies represents a risk to the long-term health of the estuary. This lack of coordination inhibits the effective management of system wide issues and cumulative impacts. It also contributes to missed opportunities in efficient and effective management (i.e. overall water quality monitoring program).
11.4	**Lack of funding for investigation and action implementation**	For both local and state government agencies, a lack of funding was consistently identified as a barrier to the effective estuary and catchment management (see Section 6.4). A lack of funding across the local government inhibits the ability to: ▪ Collect data and commission technical studies to identify key issues and threats, and assess management solutions; ▪ Implement effective management actions, including capital and maintenance works; ▪ Undertake effective monitoring and regulation of compliance effort across the river system and catchment.

An additional 17 threats were identified that were deemed as likely to become high risk over future planning horizons as a result of climate change, population pressures and future development. These are summarised in Table 8-8.

TABLE 8-8 FUTURE / EMERGING HIGH-RISK STRESSORS AND KEY ISSUES

Future and Emerging Stressors (and Associated ID from Table 8-3)
▪ 1.3 Long-term coastal shoreline recession ▪ 3.2 Ocean temperature increase ▪ 3.4 Altered storm frequency & severity ▪ 3.5 Altered hydrological regimes ▪ 3.6 Sea Level Rise ▪ 3.9 Habitat migration & squeeze ▪ 4.9 Industrial discharges ▪ 5.1 Foreshore / urban development ▪ 6.2 Modified freshwater flows (in estuaries) ▪ 7.2 Commercial boating - small commercial vessels & charters activities etc ▪ 8.2 Recreational boating ▪ 9.1 Overcrowding / congestion of waterways and user group conflict ▪ 9.2 Overcrowding / congestion of foreshore/beaches and user group conflict ▪ 9.3 Limited or lack of foreshore and waterway access ▪ 9.4 Limited or lack of supporting infrastructure (for boating etc) ▪ 12.1 Incomplete coastal process information (including climate change impacts) ▪ 12.2 Incomplete ecological information (including climate change impacts)

These emerging and future stressors are related to a number of key threats. As discussed in Section 3.7.2, there is a significant amount of future urban development and population growth projected for the wider Hawkesbury-Nepean Catchment over coming decades. The population of the Greater Sydney region is expected to increase by around 1.7 million people by 2036 (GSC, 2018), and as part of the *Greater Sydney Regional Plan* a number of key development areas designed to accommodate this growth are located within the study area catchment (Section 3.7.2). The Western Parkland City outlined in the Greater Sydney Region Plan (GSC, 2018) and adjacent developments areas are intended to support more than 250,000 new residential dwellings, as well as associated industrial and commercial centres - including the planned Western Sydney International Airport.

This *expansion and intensification of urban development across the catchment* will result in a significant increase in urban stormwater discharge, agricultural and industrial runoff, and WWTP discharges impacting on the Hawkesbury-Nepean receiving waters, both within the estuary system and higher in the catchment. Furthermore, the increase in population will also place increasing pressure on the recreational use of the study area and generate user group conflict across the waterways and foreshores of the river system and its tributaries.

Superimposed on these developmental and population pressures will be the emerging threats associated with climate change. Impacts of climate change are discussed in Section 3.2.5, and will affect the environmental, social and economic values of the study area. Projected mean sea level rise (SLR) will have impacts on the frequency and severity of tidal inundation (“sunny day flooding”), and coastal storm inundation for low lying coastal communities (discussed in Table 8-8). SLR will also affect local flora and fauna, in the form of altered salinity regime in the upper estuary, as well as habitat migration and potential for habitat squeeze in developed areas. Other stressors include increases to ocean temperatures, increased severity of coastal storm events such as east coast lows, altered rainfall regimes, groundwater recharge and surface runoff.

9 KNOWLEDGE GAP ANALYSIS

A review of existing information and a knowledge gap analysis has been undertaken in order to identify the focus areas for CMP actions, and to assist within planning of additional studies to be undertaken in Stage 2. The *NSW Coastal Management Manual Part B: Stage 2 – Determine risks, vulnerabilities and opportunities* sets forth the requirements for the nature and rigour of the information required in Stage 2 to provide information to support decision-making in later stages of the planning process. In that document, information requirements are provided for each of the four (4) coastal management areas, and these requirements have been used as a basis for determining the adequacy of the existing information - and subsequently the potential knowledge gaps to be filled.

9.1 Knowledge Gap Analysis

A review has been undertaken regarding the extent and adequacy of existing information and datasets. Historically, there has been a significant volume of work undertaken across the study area over the last 20 years, undertaken by a range of stakeholders including state government agencies, local governments, industry consultants, and academia. These include

- State based assessments;
- Regional and catchment scale assessments;
- LGA wide assessments;
- Estuary and sub-estuary scale studies and plans (such as those undertaken for Brisbane Water, and Pittwater); and
- Local site-specific studies and assessments.

9.1.1 Technical Knowledge and Studies

As part of this literature review, over 230 relevant informational studies, management plans, and additional datasets were identified and reviewed in terms of their relevance and application to the CMP. A summary of this data is presented in Appendix B. The major bodies of work relating to *risk, vulnerabilities and opportunities* across the study area comprise the following datasets, which are sorted chronologically in Table 9-1:

- The coastal and estuary management plans (and supporting technical studies) described in Section 6.1, and relevant flood risk management plans;
- The local coastal hazard studies. These are described in Section 5.2.4 in relation to their application to the CVA to be identified Stage 2 of the CMP process; and
- The MEMS Threat and Risk Assessment (BMT WBM, 2017).

These studies, assessments, and plans have been developed over recent decades, and it is important to consider the modernity of the existing body of knowledge. There are a number of studies and assessments undertaken across the study area that are becoming outdated and are in need of an update. The NSW Coastal Management Manual recommends that CMPs should be reviewed and updated at least every ten (10) years – and so it is recommended that a similar approach be adopted to the existing studies and plans across the CMP study area. Studies undertaken before 2010, which are now over ten (10) years old, will need to be updated in order to account for changes, updates and developments with regards to:

- *Coastal and environmental datasets*, including (but not limited to) tide, wave, wind, rainfall and water quality data (such as those datasets listed in Section 6.3);
- *Impacts of recent storm events*, such as the April 2015 and June 2016 east coast lows (see Section 3.2)

- *Climate change projections* and assessments of associated pressures and impacts to the coastal zone – including sea level rise estimates, and other impacts discussed in Section 3.2.
- *Local and state governance arrangements*, roles and responsibilities (see Section 3.3), including council amalgamations (circa 2016/17) and changes to state government agencies and departmental clusters (circa July 2019);
- *Coastal management policy and other relevant legislation* (see Section 3.4), such as the implementation of the MEM Act (2014), the CM Act (2016), the CM SEPP and the requirements set forth in the NSW Coastal Management Manual (OEH, 2018a);
- *State-based assessments and guidelines* for the coastal zone and marine estate, such as the *Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions* (OEH, 2017) and the *Marine Estate Management Strategy* (MEMA, 2018). Additionally, the *2017 Metropolitan Water Plan for Sydney* and *Central Coast Water Plan 2050* provide relevant technical information.
- *Regional and local strategic planning direction* (see Section 3.5), such as the *Greater Sydney Strategic Plan* (GSC, 2018), *Central Coast Regional Plan* (DoP, 2017) and the implementation of Local Community Strategic Plans (circa 2017-18) and Local Strategic Planning Statements (which are currently under development);
- *Projection of future population pressures* and changes in demographics - including recreational and commercial usage pressures (see Section 3.7); and
- *Land use modifications and urbanisation in the catchment*, particularly with relation to proposed growth areas and associated development (see Section 3.7). Environmental impacts of this development across the catchment should be considered thoroughly in the CMP process.

It was noted that, at the time of writing this report, a number of Councils were undertaking a range of studies as part of their accelerated LEP review (Local Strategic Planning Statements). Hornsby Shire Council, for example, is working on the and number of relevant documents which include:

- Environmental Sustainability Strategy (including Water Sensitive Hornsby, Climate Change Adaptation, Urban Forest and Biodiversity Strategies)
- Local Housing Strategy (including housing demand reviews)
- Active Living Strategy (including walking and cycling strategy)
- Rural Lands Review
- Economic Development and Tourism Strategy (including Employment Land Use Study)
- Waste Strategy
- Bushfire Management Strategy

These documents were not available for review in undertaking the Stage 1 Scoping Study. However, these documents will need to be considered in future stages of CMP development.

Table 9-1 shows that a significant amount of work relating the coastal and estuary processes across the system is now becoming dated, with the Lower Hawkesbury Estuary Management Plan (BMT, WBM, 2008), and Brisbane Water Estuary Process Study (CLT, 2009) now over ten (10) years old, and the Pittwater Estuary Process Study (L&T, 2003) over fifteen (15) years old.

TABLE 9-1 MAJOR BODIES OF WORK ADDRESSING RISKS, VULNERABILITIES AND OPPORTUNITIES

Assessments and Studies >10 years old	Assessments and Studies 5-10 years old	Assessments and Studies < 5 years Old
▪ Pittwater Estuary Process Study (L&T, 2003) ▪ Lower Hawkesbury Estuary Management Plan (BMT, WBM, 2008) ▪ Brisbane Water Estuary Process Study (CLT, 2008) ▪ Brisbane Water Foreshore Flood Study (Cardno, 2009)	▪ Modelling and Mapping of Coastal Inundation under Future Sea Level (CSIRO, 2011) ▪ Upper Hawkesbury River Estuary Synthesis Report (BMT WBM, 2013a) ▪ Upper Hawkesbury River Bank Erosion, Foreshore Structure and Weed Mapping Report (BMT WBM, 2013b) ▪ Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study (WorleyParsons, 2014) ▪ Lower Hawkesbury River Riverbank Vulnerability Assessment (WRL, 2014)	▪ Pittwater Estuary Mapping of Sea Level Rise Impacts (Cardno, 2015) ▪ Marine State Management Authority Threats and Risk Assessment (BMT WBM, 2017)

As part of the scoping study, it was necessary to assess the adequacy of existing information pertaining to each of the 67 stressors assessed as part of the first-pass risk assessment (discussed in Section 8.4). Subsequently, a gap analysis framework was applied to this study.

Given the size of the CMP study area, and the fact that previous studies have generally been carried out at smaller geographic scales (typically, waterway scales such as Pittwater and Brisbane Water), the study area was divided into five (5) smaller geographic waterway areas for the purposes of this assessment, comprising:

- Upper Hawkesbury River (from Yarramundi to Wisemans Ferry);
- Lower Hawkesbury River (from Wisemans Ferry to Broken Bay);
- Pittwater Estuary;
- Brisbane Water Estuary; and
- Broken Bay.

For each stressor, the adequacy of existing knowledge relating to that stressor was assessed, based on the age of the data and the spatial coverage across each waterway area. This approach provided the granularity required for a meaningful assessment. The spatial coverage within those waterway areas was categorised as:

- *Full coverage*: Full spatial coverage of the waterway, or some small geographical data gaps that are of relatively low consequence.
- *Partial coverage*: Data covers a reasonable portion of the waterway area, but significant geographical gaps still exist.
- *Minimal coverage*: Data is missing, or covers only a very small component of the overall waterway area, such as smaller site-based analyses not suitable for application to entire study area.

The framework is provided in Table 9-2.

TABLE 9-2 KNOWLEDGE GAP ANALYSIS FRAMEWORK

Data Age and Veracity	Knowledge Adequacy Across Waterway Area		
	Full coverage of Waterway	Partial coverage of Waterway	Minimal coverage of Waterway
Information is relatively recent (less than five years old), and adopts the latest technical methods and standards, and incorporates up to date information and data.	High	Moderate	Low
There are some technical data gaps, or information is between 5 and 10 years old and may therefore be somewhat outdated. Addressing this would improve the effectiveness of management.	Moderate	Moderate	Low
Data is outdated, more than 10 years old. There are significant technical data gaps, and management action cannot proceed effectively without completing and/or updating this knowledge.	Low	Low	Low

The results of the gap analysis have been used to determine the scale, scope, and nature of additional studies required during Stage 2 of the CMP, which is intended to determine risks, vulnerabilities and opportunities across the study area. The need for additional studies is based on the adequacy of the existing data, as per Table 9-3 below. The results of the knowledge gap analysis are provided in Appendix G in full, with a high-level summary provided below in Table 9-4. A summary of the studies to be undertaken in Stage 2 is provided in Section 0.

TABLE 9-3 KNOWLEDGE GAP IMPLICATIONS

Knowledge Adequacy	Description
High	Present data regarding the stressor / issue is sufficient and does not need to be undertake during Stage 2 of the CMP.
Moderate	Information regarding the stressor is incomplete and some localised or issues-based studies may be needed to fill the knowledge gap, depending of spatial coverage and veracity of technical methodology.
Low	Information regarding the stressor is insufficient and estuary-wide studies need to be undertaken during Stage 2 of the CMP to fill the knowledge gap.

9.1.2 Available Models

The Hawkesbury Nepean River and South Creek model (the HN model) is operated by Sydney Water and DPIE, as is specifically designed to provide guidance on the likely quantitative differences in water quality and quantity when contrasting different catchment conditions, environmental flows, wastewater discharges and land use scenarios over time. The HN model was developed for Sydney Water by SKM (now Jacobs Pty Ltd) in partnership with BMT WBM, eWater, University of Western Australia and Yorb. It was also independently peer reviewed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) for design and technical quality.

In particular, the HN model was developed to inform planning for growth and consider potential future changes to Sydney Water's Environment Protection Licences. The HN model allows users to better understand:

- the difference in receiving water quality and flow between diffuse and point source pollution
- the impact of wastewater treatment plant discharge in wet, dry and average weather conditions, and
- the complex interactions that can occur within such a large river system

The model has significantly improved our ability to evaluate management and planning scenarios, especially in terms of their relative impact on flows and water quality. Sydney Water is committed to continuously improve the model through processes of re-calibration and validation against contemporary observations and incorporating major catchment changes.

At the time of its completion in 2013, the HN Model was a significant step forward. However, since 2013, notable improvements have occurred in both modelling software and the scientific understanding of the catchment and aquatic processes. Sydney Water is commencing work to revise the models to leverage these improvements to make better business and wastewater management decisions for the community and the environment.

9.2 Studies to be Prepared in Stage 2

The need for additional studies has been assessed based on the outcomes of the first pass risk assessment (Section 8), the review of the adequacy of existing information (Section 9.1), and the stakeholder engagement workshops (Section 4.6). The assessment has also considered the requirements for Stage 2 of the CMP set forth in the NSW Coastal Management Manual (OEH, 2018e).

Where possible, the assessment has promoted cost and time efficiency by identifying opportunities where studies can fill multiple knowledge gaps at once (be they geographical or technical gaps). This was intended so as not to generate on overly long (or unmanageable) list of required studies. The studies required to be undertaken during Stage 2 of the CMP are provided in Table 9-5.

The improved knowledge generated by these studies will help support the identification, evaluation and selection of appropriate management actions required to address management issues in an integrated and strategic manner during Stage 3. This includes actions to support ecologically sustainable development, manage and reduce risks from coastal hazards, promote public access, improve community awareness and understanding, and support the well-being of the local community and coastal ecosystems (OEH,2018e).

TABLE 9-4 SUMMARY OF KNOWLEDGE GAP ANALYSIS

Threat Category	Upper Hawkesbury River	Lower Hawkesbury River	Pittwater Estuary	Brisbane Water Estuary	Broken Bay
Coastal and Estuarine Hazards (for more information, please refer to Section 5.2.4 and Table 5-1)	Overall knowledge adequacy: **Moderate** to **Low**. The existing bank erosion assessment was undertaken in 2013 by BMT WBM. The adopted methodology is robust, and is considered relatively recent. However, the spatial extent of the bank erosion mapping does not cover the entire Upper Hawkesbury – as it only covers the HCC LGA foreshore. Therefore, additional bank erosion mapping is required across The Hills Shire Council LGA foreshore for completeness. Tidal inundation extents and impacts have not yet been assessed across the upper estuary.	Overall knowledge adequacy: **Moderate**. The existing bank erosion assessment was undertaken in 2014 and is technically robust, but only covers the region from Wisemans Ferry to Spencer. The bank erosion assessment should be extended to cover the remaining foreshore communities across the Lower Hawkesbury. Tidal inundation and coastal inundation have been assessed by CSIRO (2011). This study adopts currently accepted SLR rise scenarios (consistent with Cardno 2015 across Pittwater) and is technically robust – however it is spatially incomplete as it only covers the southern side of the Lower Hawkesbury. The data & mapping should be extended to cover the CCC LGA foreshore.	Overall knowledge adequacy: **High** to **Low**. Foreshore erosion has been assessed as part of Pittwater Estuary Process Study (2002), and subsequent investigations by Council and DPIE (2008), though no formal mapping is available. Coastal hazard assessments of key Pittwater beaches has been ad hoc and incomplete. An updated estuary wide study is required to adequately evaluate shoreline stability across public foreshore. Estuary entrance instability is assessed for Great Mackerel Beach ICOLL (MHL, 2017). Tidal inundation and coastal inundation have been assessed by Cardno (2015), and this dataset is recent and robust, and has adopted the same SLR rise scenarios as CSIRO (2011) for the Lower Hawkesbury. This data is fit for purpose and the study does not need an update at this point. Coastal cliff or slope instability has not been assessed but is required for relevant locations.	Overall knowledge adequacy: **High** to **Moderate**. Foreshore erosion across the estuary was assessed as part of Brisbane Water Estuary Process Study (2008). Additional identification of foreshore erosion hotspots has been undertaken as part of Action W34 of the CZMP (Cardno, 2012), and is this database in considered to be up to date. The Brisbane Water Foreshore Flood Study (Cardno, 2009) assessed combined coastal and catchment inundation across the estuary. The study utilises a range of SLR scenarios that whilst not exactly consistent with the work across Pittwater and Lower Hawkesbury, remain within the range of currently accepted SLR projections. Whilst ten years old, the SLR projections and modelling methodology are considered up to date and best practice, and therefore is considered acceptable for use in the CMP. However, the flood study does not include an assessment of tidal inundation (i.e. sunny day flooding), which will need to be assessed in Stage 2 of the CMP.	Overall knowledge adequacy: **Moderate**. The assessment of coastal hazards for Broken Bay was undertaken as part of the Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study (WP, 2014), and the coastal hazard data set is around 6-7 years old. This assessment is relatively robust from a methodology standpoint. However, there has been a recent push in NSW for Councils to adopt a more technically robust probabilistic approach to developing coastal hazard lines, as opposed to the deterministic hazard lines adopted in this study. Therefore, it is considered that a renewed coastal hazard assessment should be undertaken for the Broken Bay Beaches. The CMP should ensure that the coastal hazards assessed at these Broken Bay Beaches is consistent with the methodology adopted in the Gosford Open Coast Beaches CMP.
Urbanisation and Land Use Impacts - **Waterway Use and Resource Conflict** - **Public Health & Safety**	Overall knowledge adequacy: **Moderate**. Estuary processes and values, and the impacting stressors and estuary health pressures are assessed in the Upper Hawkesbury River Estuary Synthesis Report (2013). This report covers the area from Yarramundi to Wisemans Ferry and contains relatively up-to-date information regarding interactions between key processes, including water quality, estuarine ecology, human use, and climate change. However, some spatial gaps (with regards to weed mapping etc) exist across the Hills Shire LGA stretch of foreshore.	Overall knowledge adequacy: **Moderate**. the Lower Hawkesbury Estuary Management Plan (2008) addresses key processes and values of the estuary, and the majority of the threats associated with water quality, estuarine ecology, and riparian and aquatic habitat. However, this study is now over ten years old and a review and update of the major threats and stressors is required. In particular, the assessment of water quality can be updated using the information now available through the current monitoring programs listed in Section 6.3.	Overall knowledge adequacy: **Moderate** to **Low**. Key threats assessing the water quality, hydraulic, sedimentary and ecological processes are addressed in the Pittwater Estuary Process Study (2003), which is over seventeen years old and in need of an update in order to address changing estuary pressures and updated climate change projections. This can also include use of current monitoring programs listed in Section 6.3.	Overall knowledge adequacy: **Moderate** to **Low**. The prevailing threats and pressures affecting the environmental, social and economic values of the estuary have been studied in the Brisbane Water Estuary Process Study (2008), which is nearly twelve years old, and in need of an update. In particular, the assessment of water quality can be updated using the information now available through the current monitoring programs listed in Section 6.3.	Overall knowledge adequacy: **Moderate**. An assessment of cultural, economic, and community values was undertaken during the Open Coast and Broken Bay Beaches Coastal Zone Management Study (WP, 2015). This included an assessment of recreational use pressures and resource use and conflict across the Broken Bay Beaches. This study is around 5 years old and is considered to be technically sufficient – and does not require reassessment during Stage 2 of the CMP.
	It is noted that a developing database of water quality data exists across the waterway from the various ongoing monitoring programs listed in Section 6.3 and Appendix B. These data sets should be incorporated into an updated assessment.				

TABLE 9-5 STUDIES TO BE PREPARED DURING STAGE 2 OF THE CMP

Study Name	Study Description	Rationale for Study
The Hawkesbury River System Physical Processes - Abridgment Report	This study should include a review of the physical processes at play in the study area – including catchment processes, hydraulic and water quality processes, and morphological processes. The review will collate the information from previous EPSs and other technical studies undertaken in the last 20 years, fill critical data gaps that can inform decision making during Stage 3 and bring the information together at a system-wide scale. The study area should therefore comprise the entire Hawkesbury River system, including the Hawkesbury River Estuary, the Brisbane Water Estuary, the Pittwater Estuary and Broken Bay – and their contributing catchments. The study should include a review of the following components: ▪ *Catchment Processes:* Current and future catchment land use including development, vegetation, geology and soils. This should also consider changes to catchment land use and urban intensification over planning horizons proposed under the Greater Sydney Regional Plan; ▪ *Hydraulic and Water Quality Processes:* Including: – Catchment flows across the study area, and expected impacts of future land use and other emerging issues such as the raising of the Warragamba Dam; – Ocean and estuary physical processes including tidal behaviour and hydrodynamics, flushing times, and wave climate (including ocean swell, local wind waves, and boat wake waves) – Water Quality – including sediment and pollutant loads across the study area from diffuse and point source land uses. This should include review of urban stormwater discharge, agricultural runoff, industrial discharges, sewage effluent & septic runoff and collation of information regarding EPA licenced discharges; ▪ *Morphological Processes:* This should include: – The local and regional geology and geomorphology; – Local sediment characteristics – including sediment quality and contamination, and ASS; – Estuarine morphology (including morphological sources, pathways and sinks), including sediment budgets where possible. – Fluvial morphology and siltation - updating where possible the existing knowledge of siltation issues and hot spots – Coastal and estuary erosion and riverine bank erosion. The deliverable of the study should be a succinct technical report summarising the review of the above processes - a system wide scale (noting also the need to capture and focus on local scale issues where appropriate). A key component of the study should be an assessment of potential future changes to the above components over future management horizons due to urban intensification and climate change.	There are a number of existing EPSs across the study area. However, these studies have generally been undertaken at smaller (waterway) geographical scales, and there is currently no broader study that covers the entire estuary system. Furthermore, the existing suite of EPS for the study area are largely ten years old (or older in some instances), and are in need of an update for the reasons provided in Section 9.1. There are several processes and issues that exist on a system wide scale, including water quality, ecological processes, hydrology and coastal processes, and development pressures. Given that one of the objectives of a system-wide CMP is to identify and address larger scale, system-wide issues, this study represents an opportunity to develop an in depth understanding of the connectivity of the various systems acting across the estuary as a whole. Nonetheless, the existing technical dataset represents a significant body of knowledge, and a desktop review and information synthesis (in the form of an abridgement report) will provide a review and collation of the knowledge provided in these documents, with a focus on: ▪ The broader estuary system and interactions between waterways and processes; ▪ New and emerging issues, such as the significant increase in development and population across the catchment as part of the Greater Sydney Regional Plan, and other issues such as the raising of the Warragamba Dam; ▪ Accessing new data which has been made available since the previous work was completed, such as the database of water quality information from the various ongoing monitoring programs listed in Section 6.3. This should also include new information provided in the MEMS TARA (BMT WBM, 2017); ▪ Ensuring the requirements of the Stage 2 CM Manual are satisfied, including CM SEPP mapping of coastal wetlands and littoral rainforests area; ▪ Where feasible, factoring in the framework outlined in *Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions* (OEH, 2017); ▪ Taking into account recent events that have occurred since completion of the existing documents, such as the POMS and QX outbreaks across the Hawkesbury Oyster industry circa 2013; ▪ Consistency in the application, analysis and presentation of data across the wider catchment.
The Hawkesbury River System Ecological Processes - Abridgment Report	This study should include a review of the ecological processes at play in the study area – including habitats, fauna, biodiversity conservation, and anthropogenic impacts on biodiversity and ecosystem function. The review will collate the information from previous EPSs and other technical studies undertaken in the last 20 years, fill critical data gaps that can inform decision making during Stage 3 and bring the information together at a system-wide scale. The study area should therefore comprise the entire Hawkesbury River system, including the Hawkesbury River Estuary, the Brisbane Water Estuary, the Pittwater Estuary and Broken Bay – and their contributing catchments. The study should include a review and summary of the following components: ▪ *Aquatic, Riparian and Terrestrial Habitats:* This should include a review and assessment of riparian, foreshore and aquatic vegetation around the study area such as saltmarsh, wetlands, mangroves, seagrass/ macroalgae, soft sediments and beaches. It should include an overview of the terrestrial vegetation communities across the study area, including national parks. ▪ *Aquatic, Riparian and Terrestrial Fauna:* Including a summary of aquatic and riparian fauna such as fish and prawns, mobile invertebrates, marine mammals, avifauna (birds), and oyster leases. A summary of terrestrial fauna should also be provided, including the national parks of the study area and adjacent bushland. ▪ *Threatened Species:* A review and update of the listed rare and threatened species (flora and fauna) across the estuaries and their contributing catchment. ▪ *Invasive Species:* Should also include an assessment of invasive flora and fauna pest species and diseases.	Rationale as above.

Study Name	Study Description	Rationale for Study
	▪ *Anthropogenic Impacts on Biodiversity and Ecosystem Function:* A summary of threats and stressors to ecosystem functioning, including climate change impacts, and habitat modification. The deliverable of the study should be a succinct technical report summarising the review of the above processes - a system wide scale.	
Brisbane Water CM SEPP Mapping Review and Update	This study should include a detailed assessment of the reliability of the CM SEPP mapping for *Coastal Wetlands and Littoral Rainforest* across the Brisbane Water Estuary. This assessment should be undertaken based on Councils existing vegetation mapping data and through undertaking targeted field assessments to fill key data gaps. The deliverables should include digital mapping data and a brief technical report summarising methods and outcomes.	Preliminary analysis and consultation with Central Coast Council has indicated that the Coastal Wetlands and Littoral Rainforest mapping for Brisbane Water Estuary is inaccurate in some locations, and will likely require an update based on both desktop assessment and field work.
Bathymetric Survey of Brisbane Water	An updated bathymetric survey of the Brisbane Water Estuary is required. In order to capture the Brisbane Water entrance tidal shoals, the survey should extend to the downstream limit defined by a transect directly between Umina Point and Little Box Head. The hydrosurvey should extent across the estuary in its entirety, including the Broadwater and the various embayments bays, inlets, creeks and tributaries. This should also include key navigation channels, including: ▪ Entrance Channel ▪ Paddy's Channel ▪ Lintern Channel ▪ Woy Woy Channel ▪ Wagstaffe Channel, ▪ Cockle Channel, and ▪ Saratoga Channel. Consideration should be given to the required spatial resolution across the different areas of the estuary. For example, it is expected that lower resolution would be required across the Broadwater, and higher resolution would be needed across the various bays, inlets and navigation channels where bathymetry is more varied and morphological processes are more dynamic or siltation issues may exist.	A contemporary hydrosurvey of the Brisbane Water estuary is required for a number of purposes. The survey would assist with quantitative assessments of siltation and sedimentation across Hardy's Bay, Correa Bay and other locations. More detailed information is required in order to provide accurate advice to the community and to plan any necessary dredging works. This would also assist with analysis of the dynamic morphological behaviour of the flood tide delta at the estuary entrance, and impacts on erosion across Ocean beach.
Bathymetric Survey of Pittwater Estuary	A contemporary hydrosurvey of the estuary is required for a number of purposes, particularly for developing an understanding of siltation of fluvial sediments in the upper Pittwater estuary. This would also assist with assessment of the progression of the flood tidal shoal at the estuary entrance. Rhelm (2018) also indicated that an up to date hydrosurvey of the estuary is required for assessing siltation within the estuary.	A contemporary hydrosurvey of the estuary is required for a number of purposes. It is anticipated that the survey will inform the Pittwater Coastal Hazard Assessment, and assist with developing an understanding of siltation of fluvial sediments in the upper Pittwater estuary. This would also assist with assessment of the progression of the flood tidal shoal at the estuary entrance. Rhelm (2018) also indicated that an up to date hydrosurvey of the estuary is required for assessing siltation within the estuary.
Brisbane Water and Hawkesbury River Estuary Tidal Inundation Study and Risk Assessment	Whilst some tidal inundation and coastal inundation information is available across the study area, there presently exist key data gaps that will need to be filled during stage 2 of the CMP. Therefore, a Brisbane Water and Hawksbury River Estuary Tidal Inundation Study and Risk Assessment is warranted in order to identify and assess inundation risk across the study area. The study area should comprise the Brisbane Water Estuary, and the Hawkesbury River Estuary from Broken Bay to Yarramundi (excluding Pittwater, where sufficient mapping already exists). The purpose of the study will be to model and map the extent of the following, for a range of sea level rise projections: ▪ *Brisbane Water:* Tidal inundation (i.e. sunny day flooding) – noting that sufficient coastal (storm tide) inundation mapping already exists Brisbane Water Foreshore Flood Study (Cardno, 2009); and ▪ *The Hawkesbury River (from Broken Bay to Yarramundi (excluding Pittwater):* Tidal Inundation, and Coastal inundation (storm tide) for a range of ARI's (at least 100 years ARI). The study should utilise detailed hydrodynamic modelling, using a calibrated and validated two-dimensional model. Output from the study should include detailed inundation mapping of a sufficient resolution to inform a property level risk assessment across developed area of the foreshore. However, it is noted that this resolution will not be required the undeveloped foreshore reserve and national parks frontage of the estuaries. The study should include the following components: ▪ A detailed assessment of tidal inundation across the Brisbane Water Estuary and Hawkesbury River estuary, and associated mapping. This should include potential changes to tidal regime (including tidal planes) and tidal hydrodynamics within each estuary.	Whilst sufficient coastal inundation (storm tide) information exists for *Brisbane Water* from the Brisbane Water Foreshore Flood Study (Cardno, 2009), there is presently no detailed tidal inundation (i.e. sunny day flooding) information (see Table 5-2). As described in Table 8-7, the OEH (2018c) inundation study has indicated that Brisbane Water is the third most vulnerable estuary system in the state, with over 200 properties exposed to tidal inundation for present day sea levels, increasing to around 2,000 properties with 0.5 m of SLR, and over 4,000 properties with 1.0 m of SLR. DPIE notes the OEH (2018c) study is a broadscale risk assessment and does not replace the need to undertake detailed tidal inundation studies for individual estuaries. Therefore, an assessment of tidal inundation should be undertaken for the estuary in order to identify exposed area, and to assess the associated social, environmental and economic risks. With regards to the *Hawkesbury River Estuary* - whilst coastal (storm tide) inundation mapping is presently available for the Hornsby LGA area (CSIRO, 2011), it is noted that there is presently no equivalent mapping for the north side of the Lower Hawkesbury along the CCC LGA, nor is there any coastal inundation mapping along the Upper Hawkesbury, upstream of Wisemans Ferry. Additionally, the FPRA has identified the Sydney-Newcastle railway line is at risk of future coastal inundation along the Mullet Creek stretch at Wondabyne. Given the risk level associated with this inundation, more detailed studies are warranted to fill coastal inundation data gaps at this location. Additional information can also identify other critical infrastructure at risk of coastal inundation, such as stormwater and wastewater infrastructure. Whilst coastal inundation flooding does not generally govern design flooding upstream of Spencer, attention should be paid to changes to tidal regime and tidal inundation in these upstream locations in order to assess ecological impacts. Therefore, in order to adequately assess the social, ecological, and economic impacts of sea level rise, this data gap needs to be filled by an inundation study.

Study Name	Study Description	Rationale for Study
	▪ Identification of sites within the estuary that will be exposed to temporary and/or permanent tidal inundation under both present-day conditions and for future sea level rise conditions. Include the frequency and severity of tidal inundation. ▪ Consideration of potential impacts regarding habitat 'squeeze' and upslope migration of macrophytes across the estuarine coastal zone due to rising sea levels, and opportunities for habitat expansion. ▪ Consideration of permanent groundwater impacts, including those associated with ecosystem functioning, built asset and infrastructure risks and contamination impacts. ▪ A risk assessment that identifies the social, environmental and economic risks associated with sea level rise across the estuaries. It is considered that a robust, probabilistic approach will be required in order to inform a cost benefit analysis and distributional Analysis (Stage 3) – that will inform evaluation of possible management responses (Stage 3 also).	If more efficient, the existing CSIRO mapping for the Hornsby Shore LGA region need not be superseded, but rather the remaining data-gaps filled in around it (ensuring consistent SLR projections and technical methodologies). Sufficient information regarding coastal inundation and tidal inundation already exists for the *Pittwater Estuary*, and this does not need to be updated.
Broken Bay Coastal Hazard Study Update	This study should include an assessment of hazard mapping suitable for preparing a planning proposal to update the coastal vulnerability area maps in the CM SEPP. The study area should include the Open Coast Broken Bay Beaches, including: Little Patonga Beach, Patonga Beach, Pearl Beach, Umina Beach and Ocean Beach. It should include the following coastal hazard components: ▪ Beach erosion: The storm bite allowance that determines extent of retreat of the dune scarp during a major storm event or series of storms; ▪ Shoreline recession: The underlying long-term change in the position of the shoreline due to the prevailing coastal processes as well as the effects of sea level rise; ▪ Coastal Inundation: Including storm tide and wave run-up. The study should build on the data collation tasks undertaken as part of the Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study (WP, 2014), and update data where applicable with update metocean and beach profile data. The study should include a review of the local sediment budget, and develop a quantified conceptual model of local morphological sinks, sources and pathways along the study area. This is particularly important along Umina and Ocean beaches, where morphological processes and linkages with the Brisbane Water entrance marine delta play a significant role in shoreline erosion and accretion on the beach. Patonga and Pearl beach should also consider morphological the exchange with Patonga Creek and Pearl Beach Lagoon respectively. The key component of the study should be the adoption of a probabilistic hazard assessment approach - in order to develop risk-based coastal hazard lines for use in assessing the risks to current and future development. The study should ensure that the coastal hazards assessed at these Broken Bay Beaches is consistent with the methodology adopted in the Gosford Open Coast Beaches CMP.	The assessment of coastal hazards for Broken Bay was undertaken as part of the Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study (WP, 2014). The methodology of the study adopted a deterministic approach, which is considered to be relatively robust. However, in recent years there has been a shift in the approach used to define coastal hazard lines along the NSW Coastline – to a 'risk-based' or probabilistic approach. This approach recognises the inherent uncertainty of the numerous inputs contributing to the definition of coastal hazard lines (such as storm tide levels, wave height, pre-storm beach condition etc). The probabilistic approach allows input parameters to vary randomly over a range of values which are pre-defined through probability distribution functions. The process of repeatedly combining these randomly sampled values is referred to as Monte-Carlo simulation. Analysis of the Monte-Carlo simulations is used to develop a probability curve for future shoreline retreat that describes the range of possible future outcomes over a specific planning period. The likelihood of the future shoreline position is then cross-analysed with the consequence of such movement in order to determine an appropriate coastal hazard line position that corresponds to an acceptable level of risk. This type of hazard data may be used to inform cost benefit analysis in accordance with the NSW Treasury Guidelines, and is an appropriate form of hazard information to include in a planning proposal for the purpose of mapping the coastal vulnerability area in the Coastal Management SEPP (2018). It is important to note that the WP (2014) coastal hazard work is not necessarily considered outdated, but that probabilistic hazard data is most appropriate for informing these aforementioned assessments in the coastal zone. Therefore, given the exposure of the Broken bay Beaches to coastal erosion, and the risk to coastal assets and infrastructure (see Table 8-7), it is recommended that updated coastal hazard mapping is completed for the Broken Bay Beaches as part of Stage 2 of the CMP process - in order to define updated, risk-based, coastal hazard lines for use in assessing risks to current and future development.
Hawkesbury River Estuary Bank Erosion Update	A foreshore *bank erosion* update is required for the both the Lower and Upper Hawkesbury. Across the Upper Hawkesbury, bank erosion should be mapped along the Hills Shire LGA foreshore in order to fill current data gaps. Across the lower Hawkesbury, the study can focus on riverside settlements and communities downstream of Spencer, including (but not limited to), Berowra Creek, Milsons Passage, Mooney Mooney, Brooklyn, Dangar Island, Little Wobby, Cottage Point and Patonga Creek. Outcomes of WRL (2014) may be interpreted and extrapolated in order to refine the study area sites and scope of the assessment.	The existing bank erosion assessment of the Upper Hawkesbury pertains only to the HCC LGA area (the north eastern river bank), and the Hills Shire LGA foreshore has not been mapped. Additionally, across the Lower Hawkesbury, the WRL (2014) bank erosion mapping covers only the region from Wisemans Ferry to Spencer. Completing the mapping to include the regions downstream of Spencer will fulfill the Stage 2 requirements and allow for an assessment of at-risk communities and locations.
Pittwater Coastal Hazard Assessment	Localised coastal hazard assessments are required for *key estuary beach areas* across the Pittwater Foreshore. The study area should comprise the various beaches of the waterway, including Station Beach, Snappermans Beach, Sand Point, Great Mackerel Beach, Currawong Beach, The Basin, and Paradise Beach (Rhelm, 2018). The study should consider short term storm erosion generated by ocean swell (at locations farther north towards the waterway entrance), wind-generated waves and boat wash. It should also consider long term shoreline recession due to sediment budget imbalance and future shoreline recession due to SLR, as per the requirements of the NSW Coastal Management Manual. The study should estimate Storm Demand to determine amount of sand required to be held in reserve for a storm to protect a given asset.	Existing assessments of erosion around the foreshore of Pittwater has historically been ad hoc, and existing assessments in the estuary Process Study (L&T, 2003) and by DPIE (2008) are becoming outdated. As per the NSW Coastal Management Manual, a robust and contemporary understanding of estuary foreshore erosion is required as part of the CMP. Therefore, the waterway-wide coastal erosion of key public beaches should be undertaken for the Pittwater foreshore.

Study Name	Study Description	Rationale for Study
	The study should use a combination of morphological modelling, photogrammetric analysis, and assessment of historical aerial photography. *Coastal hazard lines* should be derived for existing, 2050 and 2100 scenarios – for use in the Stage 2 risk assessment. Data/analysis should be of appropriate resolution to do all mapping/hazard assessment at lot level. The study will need to consider the existing body of work along Pittwater in order to avoid repetition. As discussed in Table 5-2, there have been some, localised coastal hazard assessments undertaken in recent times for individual beaches including: Sand Point Beach, Palm Beach, Paradise Beach, and Great Mackerel Beach.	
Pittwater Cliff/Slope Instability Assessment	A geotechnical assessment of cliff/slope instability needs to be undertaken for relevant cliffs and headlands. It is suggested that a scoping study be undertaken in order to determine the full extent of the study area and identify target sites.	An assessment of cliff/slope instability needs to be undertaken for the coastal cliffs and headland exposed to energetic ocean swell. The Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study (WP, 2014) coastal cliffs and headlands of Broken Bay – however no such assessment has been undertaken for similar locations across Pittwater.
Hawkesbury River System Socioeconomic Study	In order to inform the cost-benefit analysis undertaken during Stage 3 of the CMP, it is recommended that a comprehensive *Socioeconomic Study* be undertaken in Stage 2, as per the NSW Coastal Management Manual Part B: Stage 2 – Determine risks, vulnerabilities and opportunities (OEH, 2018e). The study should generally address Table B2.3 of OEH (2018e). The study should also include an assessment of the *economic value of the estuary system*. Initially, this should comprise a review and update of the work undertaken by Roylat (2013), whilst expanding the findings of the study to include the region upstream of Wisemans Ferry. Consideration should also be given to other existing work such as the MEMS and state-based socio-economic studies of commercial fishers (UTS, 2016a) and oyster industry (UTS, 2016b). The study should include an assessment of direct and indirect economic value of the following, as a minimum: ▪ Industries dependent upon the river system such as aquaculture, commercial fishing and agriculture; ▪ Tourism including domestic day trip recreational use; and ▪ Ecosystem services. The study should also how future management of the coast can contribute to the social and economic wellbeing of communities across Greater Sydney and the Central Coast. The second purpose of the study will be to gain a higher understanding of *the community goals, aspirations, values and priorities* for the estuary system. As discussed in Section 3.7, the study area covers a large geographic extent, and contains a diverse array of communities and cultures. Developing an understanding of range and nature of community values and uses will be needed to inform the development of the CMP. The study will need to reach a wide variety of people who value estuary system from social, economic and/or environmental points of view. It is anticipated that a combination of online engagement and community forums may be needed to adequately undertake the study, which should leverage off the work undertaken to develop the MEMS. The scope of the study should be commensurate with the requirements of undertaking cost-benefit analyses in Stage 3 of the CMP.	The NSW Coastal Management Manual recommends that comprehensive socioeconomic information is desirable when a detailed economic assessment will be prepared in Stage 3 (including cost-benefit analysis and distribution analysis). The Hawkesbury-Nepean River system CMP is of significant geographic scale, and will cover a range of issues, many of which are large, system-wide issues that require significant investment to address. It is prescient to have a sound understanding of the socioeconomic values of the estuary system, so that management options can be backed by a robust cost-benefit analysis. The Hawkesbury-Nepean River system CMP represents a significant opportunity to engage with the local community in order to understand their goals, aspirations, values and priorities for the estuary system. The outline of community values provided in Section 8.2 is based on a synthesis of historical community engagement activities and associated studies. However, in order to adequately inform the CMP, it will be necessary to have an in depth, and up-to-date understanding of community uses and values across the entirety of the study area. The values study will inform the risk assessment undertaken later in the CMP process.
Stage 2 Values, Threats and Opportunities Report & CVA Mapping	The *Stage 2 Values, Threats and Opportunities Report* should be prepared at the conclusion of Stage 2. The report should summarise the key values, threats and opportunities across the study area, as identified in the Stage 1 Scoping Study, but also incorporating the significant body of new information garnered during Stage 2 of the CMP. The report should include a *detailed risk assessment*, that builds on the FPRA undertaken in the scoping study, using the detailed, up-to-date information garnered during the Stage 2 studies. It should also address the future and emerging risk identified in the scoping study. The risk assessment should consider the *Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions* (OEH, 2017). The risk assessment and summary report will assist the Project Steering Committee in understanding the complexity of the issues and risks affecting the environmental, social and economic assets and values in each coastal management area. It will inform the Stage 3 evaluation of management options and actions. The study should also include the development of CVA Mapping for the study area. This mapping task should include an assessment of existing mapping that is fit for purpose (such as from the Brisbane	As per the NSW Coastal Management Manual (OEH, 2018e), the detailed information from Stage 2 will help set the priorities for identifying management actions in Stage 3. Stage 2 will also provide the information needed to determine the level of option evaluation required in Stage 3.

Study Name	Study Description	Rationale for Study
	Water Foreshore Flood Study and Pittwater Sea Level Rise Study), and well as new mapping developed during Stage 2 of the CMP (such as the tidal inundation mapping, and Broken Bay coastal hazard mapping). It should be noted that DPIE are currently in the process of finalising formal guidance on CVA mapping inputs and processes.	

10 FORWARD PROGRAM

10.1 Overview of CMP Stages

10.1.1 Stage 2 – Determine Risks, Vulnerabilities and Opportunities

Stage 2 of the CMP involves undertaking detailed studies that help to identify and evaluate the risks, vulnerabilities and opportunities across the estuary system (OEH, 2018e). This stage will involve the completion of a suite of technical studies listed in Section 0. The purpose of these studies will be to provide information to support decision-making in later stages of the planning process.

Community and stakeholder engagement during Stage 2 adds value to the coastal planning process by raising awareness of the significance and complexity of the issues (OEH, 2018f), and ensuring that relevant perspectives are incorporated when analysing the likelihood and consequences of events. The Community and Stakeholder Engagement Strategy in Appendix A provides an outline of the engagement activities to be undertaken during Stage 2.

10.1.2 Stage 3 – Response Identification and Evaluation

Stage 3 of the CMP involves the development and evaluation of potential management options that can address those issues identified in Stage 2 in an integrated and strategic manner (OEH, 2018f). As per the NSW Coastal Management Manual (OEH, 2018f), Stage 3 should contain the following steps:

- *Confirmation of the strategic direction for each section of the coast*: This will involve a review of risks and opportunities identified in Stages 1 and 2, in order to ensure that the overall strategic direction of the CMP reflects local values and local/regional strategic planning objectives.
- *Identification of potential management options:* This will involve developing a suite of potential management actions design to address the issues identified during Stages 1 and 2. This should involve
  - Review and collation of options/actions from existing EMP's and CZMPs (see Section 6, and Appendix E). Many of these actions are currently ongoing and have been implemented to positive effect, and therefore the derivation of management actions should heavily utilise the foundations laid across the suite of existing management plans. The development of Stage 3 of the CMP should leverage off the significant body work undertaken to develop these existing management actions.
  - The options will need to be sufficient to address larger, system-wide issues in a coordinated and collaborative manner. However, the development of options will also need to retain the detail/granularity required to sufficient address local issues across the study area. Review of, and reference to existing EMP's and CZMPs will assist in this manner.
- *Evaluation of potential actions:* The various management actions can be prioritised through examining the feasibility, viability and acceptability to stakeholders over a range of timeframes. This should also include clarification of the roles, responsibilities, timing and pathways for the actions. The actions should be evaluated through:
  - A detailed cost-benefit analysis, using the socioeconomic study undertaken during Stage 2 as a reference when assessing potential economic benefits to the study area.
  - The Stage 3 Stakeholder and Community Engagement Program. As part of this program, relevant stakeholders (discussed in Section 7.2) and the community should contribute to the identification and evaluation of management options, and be aware of responsibilities. The options should be understood by all stakeholders in terms of risks, cost and benefits. The Community and Stakeholder Engagement Strategy in Appendix A provides an outline of the engagement activities to be undertaken during Stage 3.

- *Documenting the rationale for management actions:* A business plan should be developed that demonstrates viable funding mechanisms for implementing proposed CMP actions, ensuring that they are consistent with council's IP&R framework (OEH, 2018f).

10.1.3 Stage 4 – Finalise, Exhibit and Certify the CMP

Stage 4 involves the preparation, exhibition and submission of a draft CMP to the Minister for certification (OEH, 2018g). The draft CMP should include the various components laid out on the NSW Coastal Management Manual (2018g), including:

- Snapshot of issues (coastal processes, coastal hazards, threats to biodiversity, resilience and integrity of coastal ecosystems and ecological values etc);
- Actions to be implemented by the partner councils and other public authorities.
- A business Plan identifying the full capital, operational and maintenance costs, and timing, of coastal management actions;
- Development of a coastal zone emergency action subplan (CZEAS); and
- Mapping of coastal management areas (including any proposed changes to current coastal management areas, or mapping of new coastal vulnerability areas).

The Draft CMP document should, in essence, provide a clear and succinct *statement of proposed coastal management actions* undertaken to meet state, regional and local coastal management objectives. It will outline how actions will be implemented through the IP&R framework(s) and the land-use planning systems of the partner councils. Following the completion of a draft CMP, it is likely that DPIE will review the draft CMP prior to public exhibition.

Council will place the CMP on *public exhibition* to seek feedback from all stakeholders in the form of written submissions. It is a mandatory requirement of the NSW Coastal Management Manual that the draft CMP be exhibited for a period of not less than 28 calendar days (OEH, 2018g).

All submissions will be reviewed, considered and if applicable, incorporated into the finalised version of the CMP. The Steering Committee will then review and if satisfied endorse CMP for implementation. This will also need to include approval from relevant agencies identified as having an asset or issue management role in the CMP.

The Steering Committee then submits to *Minister for certification*. The ministers may seek advice from the NSW Coastal Council during this process.

10.1.4 Stage 5 – Implementation, Monitoring and Reporting

The CMP will be implemented by the partner councils, following approval, in accordance with their respective *IP&R frameworks*, land use planning system, and associated Community Strategic Plans (see Section 10.4). This framework will guide the implementation of the CMP, ensure all required *monitoring and reporting* is completed and will provide a framework for the review and assessment of CMP outcomes (OEH, 2018h). The partner councils and project stakeholders should develop and implement a monitoring program for the delivery of the CMP.

The CM Act (section 18(1)) requires that the CMP is *reviewed at least once every 10 years*, although it should be noted that this may be undertaken sooner, for any reason, including if there are significant new circumstances which need to be considered (OEH, 2018h).

10.2 Forward Program

According to the CM Act, if a coastal zone management plan (including an emergency action subplan) was certified under the *Coastal Protection Act 1979*, then the transitional arrangements in Schedule 3 of the Act mean it will continue to have effect until 31 December 2021 unless replaced by a CMP prepared and adopted under the CM Act (OEH, 2018a). However, it should be acknowledged that this clause of the CM Act (2016) act was written before the delays that were incurred in implementing the CM SEPP, which actually came into effect on 3 April 2018.

An indicative forward program for CMP delivery based on the key milestones is outlined in Figure 10-1 below. The indicative timing and duration of each Stage of each CMP has been assessed based on the required scope of works provided in Section 9, noting that where possible studies can be undertaken simultaneously and/or in parallel. The timeframes provided below consider the following elements:

- The requirements of the community and stakeholder consultation strategy;
- Timing around Coast and Estuary Grant acquisition; and
- The required timeframes for procurement and facilitation of consultants to undertake the work.

The timing provided herein has assumed that the partner councils will engage consultants to undertake Stages 2 to 4 as discrete and sequential packages of work – as opposed to bundled together. This assumption has been based on the significant funding requirements for each stage (as estimated in Section 11), and the timing and availability involved with the acquisition of funding from the NSW Coast and Estuary Grants Program. It is noted that the rollout of CMPs to date has commonly included bundling several stages together into a single project brief in order to increase efficiency, however the majority of those projects have been smaller in cost and the geographic scale, with fewer project stakeholders and complexities.

However, if two or more stages are to be bundled together as a single package of work (which may be more feasible for Stages 3 and 4, for instance), then some time could be saved across the following tasks (which are currently included in the forward program estimates):

- Preparation of project brief;
- Release of the brief for professional services; and
- The tender process and engagement of consultants.

The exact timing of the commencement of Stage 2 is at this point uncertain, however given the timeframes associated with completion of the Stage 1 Scoping Study (March 2020), the time required for the tendering process, and the timing associated with obtaining NSW Coast and Estuary Grant funding - it is possible that Stage 2 to start sometime around mid to late 2020.

The estimated project program is depicted in Figure 10-1. Further details regarding the time of each stage is provided in the workplan and cost-breakdown in Section 11.4. The present estimation of the required timeframe is that Stage 4 completion is likely sometime between February 2023 and April 2024.

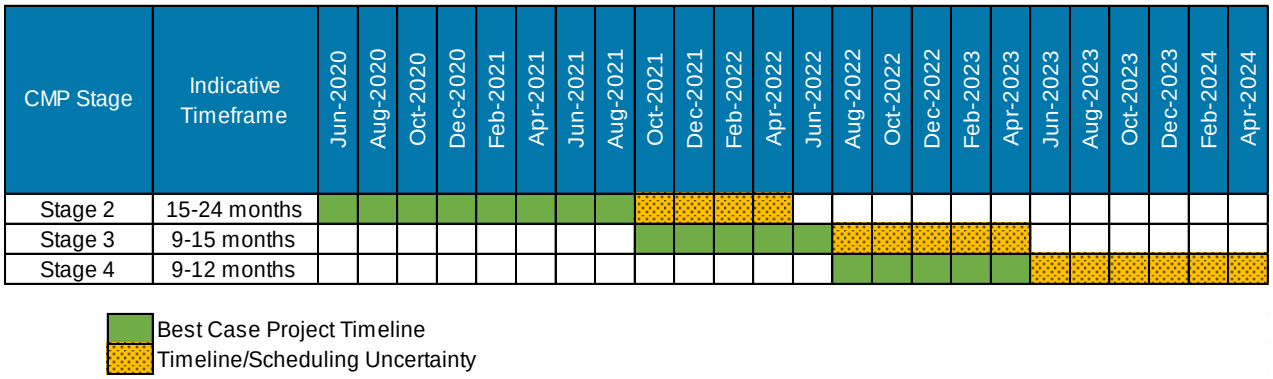


FIGURE 10-1 ESTIMATED PROJECT PROGRAM

10.3 Planning Proposals

The mechanism by which a LEP is made or amended is via a *planning proposal* – which is a document that explains the intended effect of a proposed LEP and sets out the justification for making that plan (DPE, 2016).

Sections 3.33 to 3.37 of the EP&A Act outline the processes, including the preparation of a document explaining the intended effect and the justification for the proposal. The Act requires that a planning proposal includes stated objectives, an explanation of the provisions to be included in the instrument (in this case the LEP), the justification of those provisions, details of community consultation undertaken, and maps which show the proposed application of the changes.

To assist this process, DPIE has published a *Guide to Preparing Planning Proposals* (DPE, 2016) which outlines the requirements in respect of content and process for a planning proposal.

As part of this process, the Minister for Planning (or their delegate) can issue a *Gateway determination*. It specifies whether a planning proposal is to proceed and if so, in what circumstances. The purpose of the Gateway determination is to ensure there is sufficient justification early in the process to proceed with a planning proposal. The Gateway determination will confirm the information (which may include studies) and consultation required before the LEP can be finalised. A planning proposal overview for the CMP is provided in Table 10-1

TABLE 10-1 PLANNING PROPOSAL OVERVIEW FOR COASTAL MANAGEMENT AREAS

Coastal Management Area	Planning Proposal Overview at Stage 1 of CMP
Coastal Environment Area	The Stage 1 Scoping Study has not yet identified that the CM SEPP Maps for these coastal management areas need to be amended. However, this will be assessed in more detail in Stages 2 of the CMP.
Coastal Use Area	
Coastal Wetland or Littoral Rainforest	Preliminary analysis and consultation with Central Coast Council has indicated that the Coastal Wetlands and Littoral Rainforest mapping for Brisbane Water Estuary is inaccurate in some locations, and will likely require an update. However, this will be assessed in more detail in Stages 2 of the CMP.
Coastal Vulnerability Area	At the time of preparing this Scoping Study, there was no map published under the CM SEPP to identify the CVA across the estuary system. Therefore, a planning proposal will be required to prepare an LEP which declares a map (based on the outcomes of the CMP) to be a CVA for the purposes of the CM SEPP.

10.4 Implementation

Following approval of the Stage 4 CMP document, Stage 5 of the CMP will be implemented by the partner councils IP&R framework, and their Community Strategic Plans – with implementation through their Delivery Programs and Operational Plans. This framework will guide the implementation of the CMP and ensure all required monitoring and reporting is completed. It will also provide a framework for the review and assessment of CMP outcomes. Figure 10-2 below shows how the CMP process informs, and is informed by, the elements of the IP&R framework as per the CM Manual.

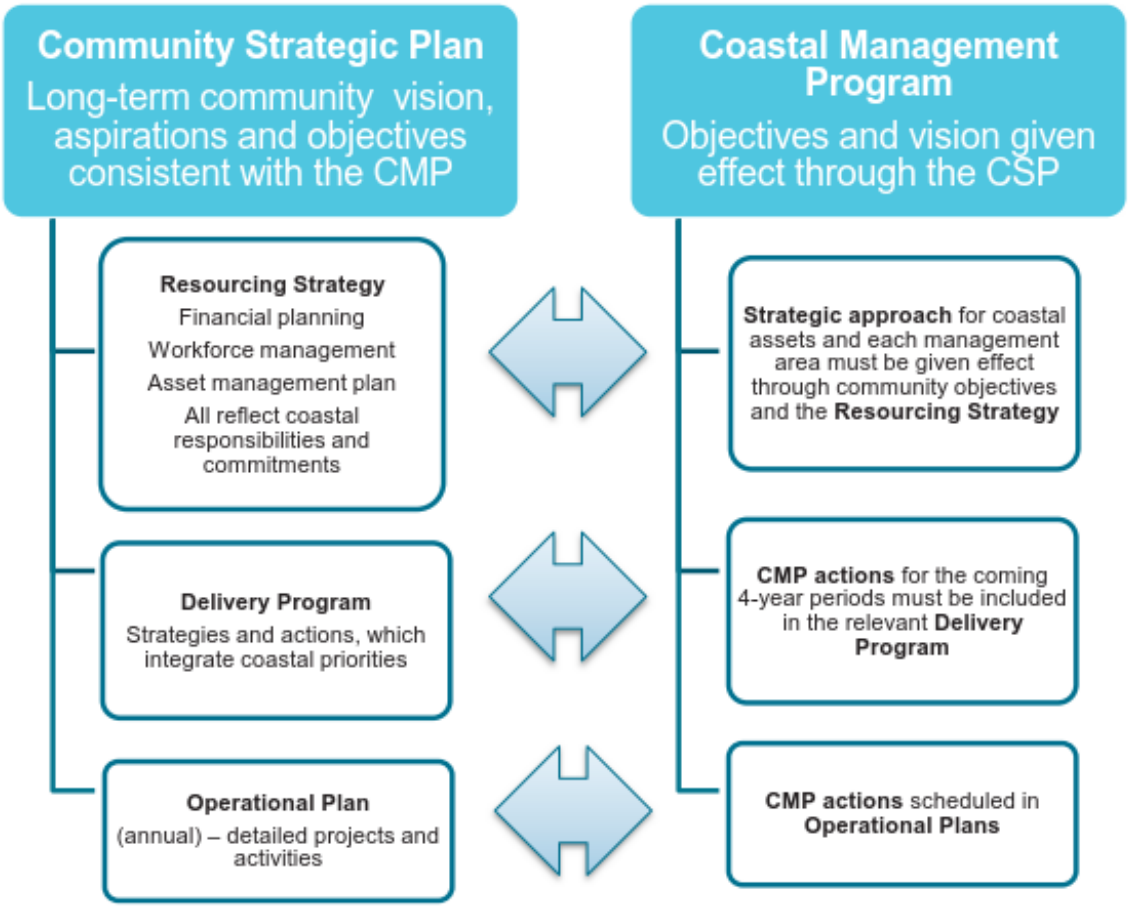


FIGURE 10-2 RELATIONSHIP BETWEEN THE IP&R FRAMEWORK AND THE CMP (SOURCE:OEH, 2018H)

11 BUSINESS CASE

This section outlines the Business Case for the development of Stages 2 through to 4 of the CMP processes. It should be noted that the scope of Stage 5 will only be known when the full suite of coastal management actions is developed during the preceding stages, and as such Stage 5 has been excluded from the Business Case. Stage 4 of the CMP process includes the development of a Business Case for the actions proposed in the CMP.

11.1 The Benefits of Undertaking a CMP

The Brisbane Water, Pittwater, and Hawkesbury River estuaries are amongst Greater Sydney and the Central Coasts greatest environmental, social and economic assets. These estuaries possess significant environmental values and are major contributors to the social and cultural wellbeing of the community. As discussed in Section 3.6, they are also a major economic resource and contribute to the economy in many important ways. Some of these include:

- *The economic value of the ecosystem services provided by the river system is approximately* ***$1bn p.a.*** *(high level estimate only)*
- *The estimated replacement value of fixed foreshore assets in the estuary is around* ***$270 million p.a.***
- *The economic value of tourism and domestic day trips across the estuary is estimated is* ***$45m p.a****.*
- *The direct economic value of industries across the estuary such as commercial fishing and aquaculture is currently around:* ***$5m p.a****.*
- *The value of associated industries that utilise the river system such as agriculture is around* ***$500m p.a.*** *(across just the partner council LGAs)*

The estimated costs of preparation of the CMP, through various elements in each stage, is outlined in Section 11.4. It can be observed from this business case, that the cost of the development of the CMP is less than 1% of the annual economic value of the estuary system – in terms of the value of economic activity in the area that is dependent on the estuary, and the economic and ecosystem service value of a healthy estuary system. Therefore, the development of the CMP is a sound investment in the coastal economy of the Hawkesbury Region.

FIGURE 11-1 RIVERBOAT TOURISM IN THE ESTUARY (SOURCE: THE AUSTRALIAN)

As discussed in Section 8, there are a range of threats that currently present a risk to the environmental, social and economic values of the system – and the system will come under increasing pressure from urbanisation, population growth and climate change over the coming decades. The development of a CMP in line with the NSW Government Coastal Management Framework is the most effective way to identify and manage the various threats and pressures facing the study area, and achieve the objectives set forth in the Coastal Management Act. A CMP will set the long-term strategy for the coordinated management of the river system – and ensure that the values and benefits of the estuary system and its catchment are enhanced and maintained for future generations.

It is anticipated that the benefits of a CMP include (but are certainly not limited to):

- The CMP will provide an opportunity to develop a strategic and integrated long-term plan. The “systems” approach of a CMP means that councils can more effectively address catchment scale issues, threats and risks, and approach river system issues in a broader strategic context;
- Improved coordination and collaboration across local and state government agencies – and a clarification of jurisdictional ambiguity across the river system. Thi should lead to a more effective and efficient management structure;
- The CMP can provide a vehicle for integration with the management initiatives and programs of the upper catchment areas. Furthermore, under recent changes to the coast and estuary grants program, upper catchment projects are eligible for funding where they can show they will improve estuary health;
- By linking with upper catchment programs and governance bodies, the CMP can improve river health across not just the estuarine reach of the study area - but across the waterways and contributing catchment of the wider Hawkesbury-Nepean River system;
- The CMP will provide a robust and defensible platform to secure funding from the NSW Government's Coastal and Estuary Grants Program;
- The structure and mandatory requirements of a CMP process are specifically designed to address the objectives of the CM Act – and will allow the partner councils to more directly address issues across the 4 coastal management areas defined in the Act;
- The CMP process provides significant pathways for community and stakeholder engagement, and can establish strong working relationships with community networks and stakeholders which are built on mutual trust and respect (OEH, 2018a);
- The risk-management process outlined in a CMP promotes the identification of current and future risks across a range of planning horizons – allowing the partner councils to adequately prepare for emerging threats;
- The preparation of a CMP will enable the funding and implementation of a number of projects that will provide benefits to the local community by improving and maintaining safe and sustainable access to the river system, and protecting public assets in areas subjected to current and future coastal hazards;
- There are significant opportunities for a project of this magnitude to leverage its large scope in order to gain funding, media attention and community buy in.

Additionally, there are a number of risks associated with not developing a CMP. These include:

- A lack of understanding of key threats to estuary values and areas exposed to coastal hazards can result in inadequate or ineffective management practices and development controls;
- The lack of a system wide approach promoted by the CMP process can result in an inability to properly address wider, catchment scale issues and threats;
- The lack of an adequate risk management process can result in a lack of ability to effectively evaluate and prioritise management actions - reducing the cost-effectiveness of government efforts and resources;

- The continuation (or exacerbation) of jurisdictional ambiguity between local and state government agencies and organisations.
- A lack of engagement with the local community can result in a lack of support or even opposition amongst the community and key user groups. This can result in a deficit of credibility and trust between the partner councils and the community, and can derail the implementation of future management actions;
- A lack of engagement with the local community around key values and issues can result in an incomplete or understanding of local community values – and therefore a misdirection of management effort and resources.

11.2 Support for the CMP Process

The Stakeholder Engagement workshop (Section 4.6) undertaken as part of this scoping study demonstrated significant support from attending representatives for the development of a Hawkesbury-Nepean River system CMP, across a broad range of local and state government agencies. Discussion during the workshop demonstrated that there is a clear desire amongst key stakeholders for a strategic, coordinated, and collaborative approach to management of the estuary system. It was recognised that the development of a CMP, driven by a Steering Committee comprising a range of stakeholders, would be the most effective vehicle to achieve these outcomes. The ongoing commitment to a system wide approach will be determined through willingness of public authorities to progress with the development (and implementation) of a whole of Hawkesbury-Nepean River system CMP.

11.3 Funding Mechanisms and Cost Sharing

11.3.1 The NSW Coastal and Estuary Grants Program

The costs associated with delivery of the CMP can be partly funded by the NSW Coastal and Estuary Grants Program administered by DPIE. The program supports coastal and estuary planning projects and the implementation of works identified in certified CZMPs or CMPs. Funding is available under 5 funding streams: a planning stream and four (4) implementation streams. The development of the CMP could be partly funded through the planning stream, which provides funding for planning projects that aim to:

- Develop of a CMP;
- Transition an existing CZMP into a CMP; and,
- Undertake investigations and designs or cost benefit analyses for infrastructure works recommended in a certified CZMP or CMP.

In late 2019, the NSW Government undertook a project examining ways of improving local government access to funding under this package. The independent report listed 38 recommendations for consideration. DPIE has considered those recommendations and has prepared an official Agency Response (DPIE, 2020). Thirty-two recommendations have been accepted, 1 partially accepted, 4 are under further investigation and 1 was not accepted. The accepted recommendations relevant to the preparation of the CMP include:

- An increase the funding ratio for coastal and estuary grants (both planning and implementation streams) to 2:1 as per the Department's floodplain management grants. This is an increase from the previous grant funding split, where the preparation of CMPs were eligible for 1:1 funding support. This means that two-thirds of the costs for preparing the Stages 2 to 4 of the CMP are eligible for funding under the grants program – effective from the next funding round.
- Upper catchment projects are eligible for funding where they can show they will improve estuary health. The program guidelines will provide more clarity in the next funding round on marine estate and amenity projects.

- Further clarification on how the local government contribution is calculated in relation to multi-council CMPs will be added in to the funding guidelines in consultation with stakeholders for the next funding round.
- Increase the funding available for project management costs in multi-council CMPs development to 20%. This is now amended to apply where five or more councils are involved.

11.3.2 Potential Funding Arrangements

As two-thirds of the costs for preparing the Stages 2 to 4 of the CMP are eligible for funding under the coast and estuary grants program, the remaining one-third of the costs will largely be funded by the partner councils under a proportionate co-funding arrangement. Such cost sharing arrangements will need to be discussed and negotiated with the partner councils and potentially other project partners (such as catchment councils and state government agencies). Detailing the specific cost-sharing arrangements for the CMP is outside the scope of this study. However, there are a number of options that may be considered for proportioning the financial contribution of each partner council. These options need to consider issues such as equity, rate payer bases, and the proportionality of foreshore and waterway area across the six (6) partner council LGAs, and the distribution of key risks and issues. For the purposes of context, some nominal options for funding arrangements are described below and summarised in Table 11-1:

- *Equal funding:* Under this arrangement, the costs of the CMP would be divided equally amongst the partner councils. After the contribution of the DPIE coast and estuary grant funding, the remaining 33.3% would be funded through an approx. 5.6% funding contribution from each council.
- *LGA Population:* This option would apportion funding commitments based on the rate-payer base within each LGA, as approximated by the LGA population (see Table 3-20). However, this option does not account for the fact that some LGAs (such as Central Coast) contain a significant population within the LGA that does not reside within the contributing catchment. Hence, this option is limited from an equity perspective. A more robust approach may be to assess the relative population of each LGA that resides within the contributing catchment of the study area, based on ABS census data (Statistical Area Level 1 and 2 data). Such detailed demographic analysis is outside the scope of this study.
- *Contributing Catchment Size:* One method for distribution may include proportioning funding by the relative size of the contributing catchment area within each LGA. However, from an equity perspective this may not fully consider the land use and/or population density within each LGAs contributing catchment. For instance, under such a method there would be a significant contribution from Hawkesbury City Council relative to the other five councils owing to its larger contributing catchment size.
- *Coastal Environment Area Size:* This method would involve apportioning funding commitments based on the relative area of the CM SEPP mapping of the Coastal Environment Area (see Figure 5-1) within each LGA. The Coastal Environment Area includes waterway area and foreshore buffer area, and may therefore serve as a preliminary, high level approximation of the distribution of key issues and responsibilities. However, this method does not account for the contribution of catchment-based issues and management actions within the CMP.

It is likely that none of the options outlined above are entirely representative of an equitable method for proportioning the financial contribution of each partner council. The eventual cost sharing arrangements may be apportioned by a different method, or by a combination of the various options outlined above. Nonetheless, the respective funding contributions of each council under the aforementioned options are provided in Table 11-1 for informational purposes. These breakdowns have been based on preliminary demographic and geospatial analyses. It should be noted that these examples should not be interpreted as recommendations for levels of financial contribution, but rather recognised as hypothetical arrangements for consideration.

TABLE 11-1 POTENTIAL COST SHARING ARRANGEMENTS

Potential Option	Central Coast	Northern Beaches	Ku-ring-Gai	Hornsby Shire	Hills Shire	Hawkes-bury City	State* (DPIE)
Equal Funding	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	66.7%
LGA Population	10.2%	7.9%	3.7%	4.5%	5.0%	2.0%	66.7%
Contributing Catchment Size	7.0%	1.1%	0.2%	3.4%	2.5%	19.1%	66.7%
Coastal Environment Area Size	19.9%	2.9%	0.1%	6.1%	1.1%	3.2%	66.7%

** This incorporates DPIE coast and estuary grant funding support, which provides 2:1 funding with the partner councils*

There may also be options for attracting funding from other sources. Given the strong influence of catchment processes and the prevalence of catchment based issues across the study area (see Section 8), it may be possible to obtain some degree of CMP funding from the eighteen (18) catchment councils that are situated within the wider study area catchment (see Table 3-8). It is also noted that one of the benefits of a system-wide CMP would be to serve as strong platform for attracting federal government and/or private funding to address larger issues and risks (as discussed in Section 7.1).

Furthermore, there is additional incentive for the partner councils to prepare a CMP - in that future Coastal and Estuary Grants Program funding for the implementation streams will require councils to have a certified CMP in place.

11.4 CMP Workplan and Cost Structure

A preliminary work plan has been prepared based on the five-stage process for preparing CMPs outlined in the NSW Coastal Management Manual (see Figure 1-2). The work plan includes an outline of the various tasks to be undertaken for each stage of the CMP, the indicative timing required to complete those tasks, and a preliminary estimate of the required budget.

11.4.1 Methods and Limitations

It should be noted that there are a number of limitations associated with the cost estimates provided for this business case. Consequently, the costs provided in Table 11-2 and Table 11-3 should be considered as initial estimates, and indicative only. These costs have been estimated through analysis of the required person-hours needed for each study, based on typical consultancy rates for junior, intermediate, and senior staff. The costs have also factored in the potential requirements for field studies (e.g. for ecological mapping) and in-situ data collection. Costs have been cross-referenced with historical project costs for EMPs and CZMPs across similar environments to ensure robustness (factoring for inflation), and have also taken into consideration the economies-of-scale cost efficiencies associated with undertaking a system-wide CMP.

It also should be noted that here are considerable cost uncertainties related to stakeholder and community engagement in Stages 2 to 4. This is because the specific risks to communities is unclear at this stage, and based on the risk assessment (Stage 2) and analysis of management options (Stage 3), the level of engagement may be considerably greater than that outlined in the Stakeholder and Community Engagement Strategy (Appendix A). Due to the labour-intensive nature of some engagement activities (e.g. interviews, drop-in sessions), additional engagement may be relatively costly.

The cost-estimates provided herein also include the funding of the project coordinator role described in Section 7.2. The estimate for this cost is based on the assessment that the role would require employment on a 0.4 EFT basis during Stage 2 of the CMP. The cost of funding this role has therefore been estimated assuming a nominal salary of $100k p.a. at 40% utilisation for the duration of Stage 2. It has been assumed

that for Stages 3 to 4, the consultants undertaking the CMP project work would assume project coordination responsibilities.

An estimation has also been made of in-kind costs incurred by the partner councils across the life of the project. They are an estimate of the time and value of council staff required to service the CMP from Stages 2 to 4. Types of in-kind activities may include liaison with internal council departments and councillors, compilation and synthesis relevant council data, fulfilling data requests, and coordination with the steering committee, project coordinator and/or consultants – to name just a few. These costs have been estimated at 30% of the projects fees for the various tasks required for Stages 2 to 4 (depicted in Table 11-2). These costs would be absorbed by the various partner councils as the project progresses, based on required staff commitment.

Whilst the greatest care has been undertaken during the risk assessment and gap analysis, it is possible that the detailed studies undertaken during Stage 2 of the CMP may highlight the need for additional data and/or studies (likely at a local scale). If these studies are required to adequately inform the assessment of management options during Stage 3 (as opposed to merely being a recommended action arising from Stage 4), then these will add to the cost of the Stage 2 assessment.

11.4.2 Work Plan and Cost Structure

A preliminary work plan and nominal cost structure is provided in herein:

- Table 11-2 outlines cost for the various studies identified for Stage 2. For this stage, potential cost sharing arrangements have been provided based on the 2:1 coast and estuary grants funding model outlined in Section 11.3. This is a nominal cost breakdown for informational and discussion purposes only, and should not be considered as a recommendation for levels of financial contribution. It assumes that the remaining one-third of funding would be split equally amongst the partner councils, assuming that each partner council would contribute to each Stage 2 study that involves their LGA. This breakdown also includes the funding of the project coordinator role described in Section 7.2.
- Table 11-3 outlines the work plan and cost structure for Stages 3 and 4.

TABLE 11-2 PRELIMINARY WORK PLAN FOR AND COST STRUCTURE FOR STAGES 2

Component	Prelim. Cost Est.	Likely Cost Range	Indicative Timing	Potential Cost Sharing Arrangement^						
				Central Coast	Nthrn Beaches	Ku-ring-Gai	Hornsby Shire	Hills Shire	Hawkes-bury	State* (DPIE)
The Hawkesbury River System Physical Processes - Abridgment Report	$60k	$40-80k	4-6 mo.	$3k	$3k	$3k	$3k	$3k	$3k	$40k
The Hawkesbury River System Ecological Processes - Abridgment Report	$40k	$30-50k	4-6 mo.	$2k	$2k	$2k	$2k	$2k	$2k	$27k
Brisbane Water CM SEPP Mapping Update	$30k	$20-50k	2-4 mo.	$10k	$0	$0	$0	$0	$0	$20k
Bathymetric Survey of Brisbane Water Estuary	$35k	$20-50k	1 mo.	$12k	$0	$0	$0	$0	$0	$23k
Bathymetric Survey of Pittwater Estuary	$25k	$20-40k	1 mo.	$0	$8k	$0	$0	$0	$0	$17k
Brisbane Water and Hawksbury River Estuary Tidal Inundation Study and Risk Assessment	$120k	$90-150k	4-6 mo.	$8k	$0	$8k	$8k	$8k	$8k	$80k
Broken Bay Coastal Hazard Study Update	$50k	$40-70k	3-6 mo.	$17k	$0	$0	$0	$0	$0	$33k
Hawkesbury River Bank Erosion Update	$60k	$50-80k	3-6 mo.	$5k	$0	$0	$5k	$5k	$5k	$40k
Pittwater Coastal Hazard Assessment	$40k	$30-60k	3-6 mo.	$0	$13k	$0	$0	$0	$0	$27k
Pittwater Cliff/Slope Instability Assessment	$30k	$10-40k	2-4 mo.	$0	$10k	$0	$0	$0	$0	$20k
Hawkesbury River System Socioeconomic Study	$80k	$60-110k	3-4 mo.	$4k	$4k	$4k	$4k	$4k	$4k	$53k
Stage 2 Values, Threats and Opportunities Report & CVA Mapping	$90k	$60-130k	4-6 mo.	$5k	$5k	$5k	$5k	$5k	$5k	$60k
Community and Stakeholder Engagement activities associated with Stage 2 (as outlined in Appendix A)	$60k	$50-70k	#	$3k	$3k	$3k	$3k	$3k	$3k	$40k
Cost of Project Coordinator. Estimated at 0.4 EFT for duration of Stage 2.	$60k	$50-80k	#	$3k	$3k	$3k	$3k	$3k	$3k	$40k
Approx. Stage 2 Subtotal	**$780k**	**$580 - 1.1m**	**15-24 months**	**$73k**	**$53k**	**$30k**	**$35k**	**$35k**	**$35k**	**$520k**

** This incorporates the fact that the CMP Stage 2 studies are eligible for DPIE coast and estuary grant funding support, which provides 50:50 funding with the partner councils. # These activities would be ongoing throughout Stage 2. ^Numbers are rounded to the nearest thousand for clarity.*

TABLE 11-3 PRELIMINARY WORK PLAN FOR AND COST STRUCTURE FOR STAGES 3 AND 4

Component	Prelim. Cost Estimate	Likely Cost Range	Indicative Timing
Stage 3 - Identify and Evaluate Options			
Stage 3 involves the identification and evaluation of management options. This options assessment should include the following, as per the CM Manual: ▪ Confirmation of the strategic direction ▪ Identification of potential management options ▪ Evaluation of potential actions ▪ Documenting the rationale for management actions	$310k	$260-400k	9-15 months
Community and Stakeholder Engagement activities associated with Stage 3 (as outlined in Appendix A)	$60k	$50-70k	*Throughout the above*
Approx. Stage 3 Subtotal	**$370k**	**$310-470k**	**9-15 months**
Stage 4 – Prepare, Exhibit, Finalise and Adopt CMP			
Stage 4 involves the development of the draft CMP document, via the following process: ▪ Preparation of the Draft CMP ▪ Exhibition of the draft CMP ▪ Reviewing and adopting the draft CMP ▪ Submitting the draft CMP to the Minister for certification	$150k	$110-200k	9-12 months
Community and Stakeholder Engagement activities associated with Stage 4 (as outlined in Appendix A)	$20k	$10-30k	*Throughout the above*
Approx. Stage 4 Subtotal	**$170k**	**$120-230k**	**9-12 months**
Approx. Total for Stages 2 to 4	**$1.3m**	**$1.0-1.7m**	**2½ - 4 years**

The funding estimates provided in Table 11-2 and Table 11-3 are based on the assumption of the implementation of a system-wide CMP. However, it is noted that after completion of Stage 1, the partner councils may prefer to instead undertake a suite of estuary based CMPs (see Section 7.1 for further discussion). Under such an approach, the partner councils would likely lose the efficiencies associated with economies of scale and reduction of duplication, and hence the cost estimates may need to be revised.

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WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

APPENDIX A
COMMUNITY & STAKEHOLDER ENGAGEMENT PLAN

Hawkesbury-Nepean River System
Coastal Management Program

Community and Stakeholder Engagement Strategy

COMMUNITY AND STAKEHOLDER ENGAGEMENT STRATEGY

BACKGROUND INFORMATION

The Hawkesbury-Nepean River system is a major social, environmental and economic asset for Greater Sydney and the Central Coast. It contains beautiful iconic beaches, sprawling rivers and estuaries, and areas of significant social and cultural significance. Along with being a key economic driver for the region, the coastal zone also contains a passionate local community, who are heavily invested in its utility and management.

Under the recent NSW Coastal Reforms, future coastal management for the estuary will take the form of a Coastal Management Program (CMP). The six local councils that border the estuarine reach of the river system have come to the agreement of partnering in the development of an integrated, whole-of-estuary, CMP. The six councils are:

- Central Coast Council
- Hawkesbury City Council
- The Hills Shire Council
- Hornsby Shire Council
- Ku-ring-gai Council
- Northern Beaches Council

The CMP comprises a five-stage development process (Figure 1).

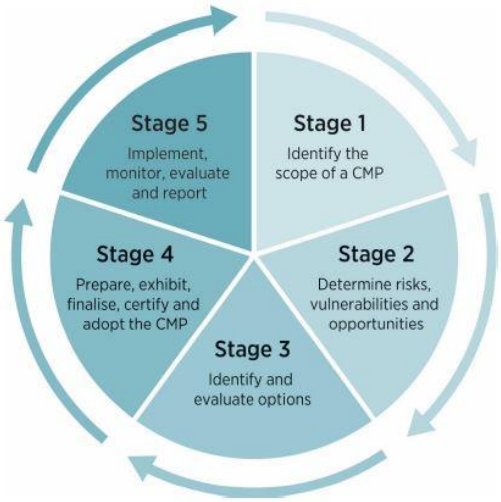

Figure 1: Stages of the CMP Process

Part of the NSW Coastal Reforms is the *Coastal Management Act 2016*. The Act (Section 16) requires councils to consult with the community and stakeholders before adopting a CMP. Part A of the coastal management manual (the manual) includes

statutory provisions and mandatory requirements relating to community and stakeholder engagement.

To fulfil these requirements, the NSW Government recommends that councils prepare a coastal community and stakeholder engagement strategy in Stage 1 of the CMP process to assist in identifying how the council/s will engage with the community and stakeholders during the preparation and implementation of the CMP.

DEVELOPING THIS STRATEGY

This community and stakeholder engagement strategy was prepared according to guidelines issued by the NSW Government titled 'Guidelines for community and stakeholder engagement in coastal management'.

As recommended in the Guidelines several documents were analysed in the development of this strategy including:

- Coastal Zone Management Plans (CZMPs) and Estuary Management Plans (EMPs) already developed in the Hawkesbury River system through community and stakeholder engagement
- The community engagement strategies of each of the six partnering councils including those used in the development of their Community Strategic Plans
- Community surveys and research on community values in the Hawkesbury River system (e.g. for the Water Quality Guidelines)
- Engagement strategies from other CMP processes (e.g. Sydney Harbour).

During Stage 1 of the CMP process a workshop was held to help develop this engagement strategy. The workshop consisted of coastal technical experts and communications/community engagement staff from each of the partner councils and NSW Department of Planning, Industry and Environment (DPIE). The workshop provided an insight into how the Guidelines provided by the NSW Government could be tailored to the Hawkesbury River system communities.

This strategy uses the International Association for Public Participation (IAP2) spectrum. The spectrum provides a framework for defining the appropriate role of community and stakeholders in an engagement process. It identifies five levels of engagement, the goal of each level and the community's role in decision-making and implementation. Generally, the Stages 2, 3 and 4 use Inform, Consult and Involve activities, whilst there are opportunities for Collaborate and Empower activities particularly in Stage 5.

It should be noted that this Strategy provides general approaches for the five stages in the Hawkesbury River system CMP process. It particularly notes some engagement activities that can be conducted across the local government areas. However, each council may want to develop its own community engagement plan for activities specifically related to its own LGA.

PURPOSE OF ENGAGEMENT

The purpose of engagement for each stage of the CMP process is:

- STAGE 1 - Bring all interested parties on board early to share information and ideas (before decisions are made).
- STAGE 2 - Empower community and stakeholders with knowledge to contribute to decisions in subsequent stages. Share information equitably among stakeholders.
- STAGE 3 - Share the decision-making dilemma. Establish a process that will be used to choose between options, incorporating community preferences and criteria.
- STAGE 4 - Gain community confidence and support for decisions that are in the documented CMP.
- STAGE 5 - Maintain community support for and commitment to the CMP, especially among those directly involved in, or impacted by the implementation.

STAKEHOLDERS

Community – There are a broad range of community sectors across the Hawkesbury River system study area including:

- Residents (ratepayers and non-ratepayers)
- Tourists
- Non-resident workers
- Environment groups
- Progress associations and other community groups
- Business organisations including chambers of commerce
- Community recreational groups including Surf Life Saving Clubs
- Schools and other education institutions
- Retirement homes and other aged facilities
- Commercial boating and tourism operators
- Commercial fishers and aquaculture farmers e.g. oyster farmers

It should be noted that an individual can be in one or more of these groups.

Indigenous groups – Indigenous representative groups (IRGs) should be engaged with in all stages of the CMP process. These groups include three Local Aboriginal Land Councils (LALCs) located in the Hawkesbury River system CMP study area:

- Darkinjung LALC
- Deerubbin LALC
- Metropolitan LALC

Council – It is important that councillors from each of the six partnering councils are briefed and engaged throughout the CMP process as they are the elected representatives and conduits to their communities.

Internal engagement should be conducted in the councils with relevant divisions at least including environment, planning and communications/engagement sections, roads & drainage, water & sewer, open space & recreation.

Council networks with communities should be utlised in the engagement. These networks could include community reference groups, estuary management groups, youth panels.

Councils in the upper catchment (outside the study area) should also be included in the stakeholder engagement.

State government agencies – Figure 2 shows the NSW Government agencies that are directly involved in the CMP process.

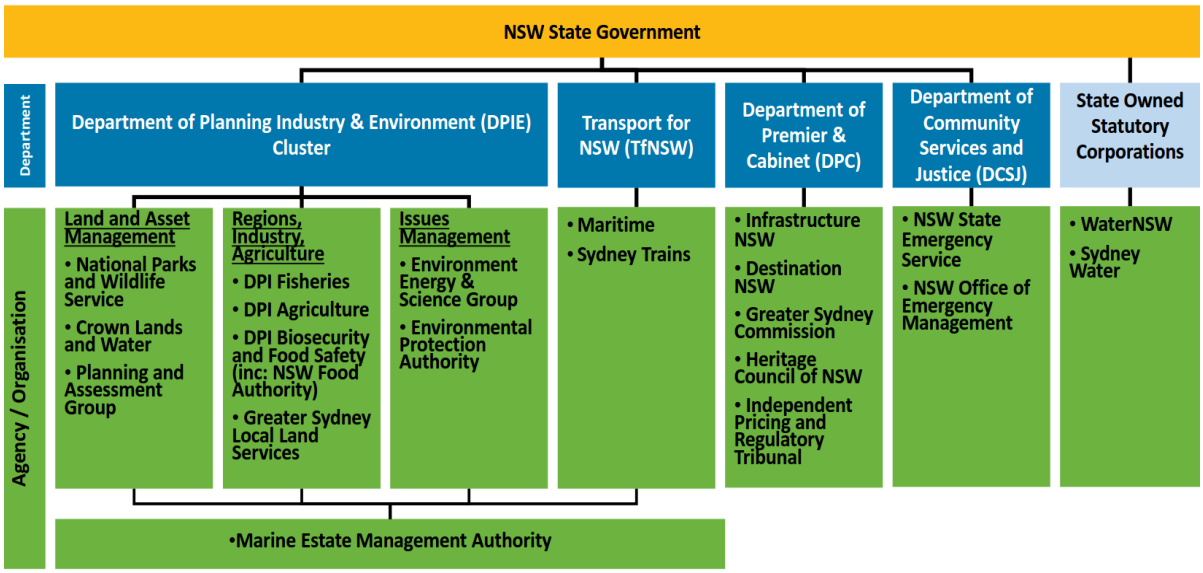

Figure 2: State Government agencies directly involved in the CMP process

It should be noted that based on the CMP risk analysis (Stage 2) and mitigation option analysis (Stage 3) other agencies may be identified for community engagement e.g. those managing vulnerable infrastructure.

STAGE 1 ENGAGEMENT STRATEGIES

Engagement outcomes	Stakeholders	IAP2 Spectrum	Content & messages	Methods
1.1. Stakeholders and the community understand how they can be involved in the preparation of a CMP	Transfer to Stage 2 (Strategy 2.1)	Inform	See Strategy 2.1	See Strategy 2.1
1.2. Establish working relationships built on mutual trust and respect	Council staff including upper catchment councils,, IRGs, State government agencies	Consult, Involve	Stage 1 CMP scoping study with project partners	Stakeholder meetings, project website
1.3 Understand community goals, aspirations, values and priorities	Council staff, IRGs, State government agencies	Involve	Diverse views across communities in the Hawkesbury River system	Analysis for Stage 1 report
1.4 Understand community motivations to participate in planning and implementation	Council staff, IRGs, State government agencies	Consult	Broad range of reasons to participate including sea level rise concerns, NIMBY	Discussions with Council communications staff, previous CZMPs, EMPs
1.5 Help community understand dynamic nature of coastal processes and the need to set long-term objectives	Transfer to Stage 2 (Strategy 2.2)	Inform	See Strategy 2.2	See Strategy 2.2
1.6 Increase community understanding of the new legislative and planning framework	Transfer to Stage 2 (Strategy 2.3)	Inform	See Strategy 2.3	See Strategy 2.3
1.7 Determine the engagement activities that are required during the preparation of subsequent stages of the CMP	Council staff	Consult, Involve	General guidance in this Strategy	Workshop with Council staff to help develop this Strategy

STAGE 2 ENGAGEMENT STRATEGIES

Engagement outcomes	Stakeholders	IAP2 Spectrum	Content & messages	Methods
2.1 Stakeholders and the community understand how they can be involved in the preparation of a CMP	Community including individuals, Council, IRGs, other stakeholders including upper catchment councils and other stakeholders	Inform	The intent of the CMP and opportunities for community and stakeholders to be involved in the planning process. Should also describe the intent of a CMP and the process in its development	Media releases, social media and council newsletters (community), council websites, councillor and council staff briefings (council), meetings with IRGs, letters to relevant government agencies
2.2 Help community understand dynamic nature of coastal processes and the need to set long-term objectives	Strategically selected community groups and user groups e.g. fishers (based on CMP risk analysis), chambers of commerce	Inform	The dynamic nature of coastal environments and the hazards associated with future coastal processes including sea level rise and threats to environmental values. The benefit of a risk management approach	Fact sheets on project website, presentations to community groups including those with high risk e.g. sea level rise impacts impactful behaviours
2.3 Increase community understanding of the new legislative and planning framework	Community including individuals, councillors	Inform	The NSW coastal management framework comprising the CM Act, CM SEPP, coastal management manual and the NSW Coastal Council	Media releases, social media and council newsletters, websites (community), councillor briefings (council). Link with Strategy 2.1
2.4 A shared understanding of risks and opportunities over different timeframes, and the range of actions that could address different risks	Community groups, council IRGs, other stakeholders	Consult, Involve	Identification of risks (e.g. flood, water quality, habitat) and opportunities on a community basis .e.g. Woy Woy/Umina peninsula. The identification of risk management actions	Community coast focus groups identified based on CMP risk analysis e.g. community, user group-based, Councillor briefings, Council staff workshop, meeting with IRGs,

				government agency workshops
2.5 A shared understanding of the varied perspectives about coastal management within the community	Community groups, council IRGs, other stakeholders. Also involve upstream councils	Consult, Involve	Use a holistic, catchment – based approach. Consider upper catchment impacts	Link with Strategy 2.4 methods. Also run a workshop on coastal impacts with upper catchment Councils outside of the study area
2.6 Council understands community's 'attitude to risk'	Community, Council	Inform, Consult	The range of attitudes to risk in communities across the study area	Use a community survey to ascertain the communities' attitude to the various coastal risks (current and future). These surveys could be run through the community parts of Strategies 2.4 and 2.5. The survey could also be on the project website and an interactive map used where people can pin what they perceive as risks. Results are provided to councillor briefing and meeting of relevant council staff.
2.7 Community and stakeholders understand vulnerabilities, risk and opportunity studies, including technical aspects such as scenarios for sea level rise, hazards and impacts	Community, council, IRGs, other stakeholders	Inform, Consult	Provide evidence on coastal vulnerabilities and risks as a result of Stage 2 analysis	Briefing as part of Strategies 2.4, 2.5 and 2.6 methods. Use fact sheets on project and council websites to report findings of Stage 2 analysis
2.8 Increased community trust of technical information based on their involvement and understanding of assumptions and limitations	Community, council, IRGs, other stakeholders	Inform, Consult	Understanding trade-offs e.g. if you focus on one risk and management option others may not be possible	Link with Strategy 2.7 methods

STAGE 3 ENGAGEMENT STRATEGIES

Engagement outcomes	Stakeholders	IAP2 Spectrum	Content & messages	Methods
3.1 Strong working partnerships	Community, council, IRGs, other stakeholders	Involve, Collaborate	We do better together	Use and promote existing working partnerships e.g. CMP project partners, Council-community networks e.g. resident associations, chambers of commerce, IRGs, estuary management committees
3.2 Managers within council aware of coastal hazards, threats, risks and vulnerabilities, opportunities and actions relevant to their responsibilities and potential conflict with other council priorities	Councils in study area, upstream councils (outside of the study area)	Inform, Consult	Awareness of intrinsic linkages across council related to CMP risk analysis findings Need to ties CMP strategic planning across divisions	Use council internal working group, workshop with council managers to review CMP risk analysis, what it means for councils and implications of possible CMP actions
3.3 Public authorities contribute to identification and evaluation of management options, are aware of responsibilities and accept the adaptive nature of the CMP	Public authorities that may be involved in CMP actions	Consult, Involve	Section 16 of the CM Act requires that councils consult with public authorities if the CMP proposes actions or activities to be carried out by that public authority or if the CMP relates to, affects or impacts on any land or assets owned or managed by that public authority.	Meetings with relevant public authorities to identify and evaluate management options and their responsibilities

3.4 Robust options, understood by all stakeholders in terms of risks, cost and benefits	Community, councils, IRGs, other stakeholders including upstream councils	Inform, Consult, Involve	Options backed by data and reflect community values	Fact sheets on project and council websites, community focus groups (return to those used in Strategy 2.4) to review management options, continued dialogue with IRGs, councillor workshop, for council mangers link with Strategy 3.2), for government agencies use Strategy 3.4, for all stakeholders use Strategy 3.1(e.g. provide information and engagement through these networks)
3.5 Council understands stakeholder views about cost-benefit distribution, willingness to pay and potential trade-offs	Councils	Inform, Consult	Council understands stakeholder views and implications for the choice of management options	Use internal council working group to review stakeholder views and implications for management options. Communicate this to upper management and councillors via briefings

STAGE 4 ENGAGEMENT STRATEGIES

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Engagement outcomes	Stakeholders	IAP2 Spectrum	Content & messages	Methods
4.1 Community and stakeholder support for actions and priorities in the CMP	Community, councils, IRGs, other stakeholders including upstream councils	Inform, Consult, Involve	It is a mandatory requirement that a draft CMP must be exhibited for public inspection at the main offices of the councils of all local government areas within the area to which the CMP Community and stakeholder engagement guidelines applies, during the ordinary hours of those offices, for a period of not less than 28 calendar days, before it is adopted.	Exhibition at main offices of each partnering council, draft CMP available on council websites and project websites with online feedback form, hold drop-in session in each LGA to brief community on draft CMP and obtain feedback, continue dialogue with IRGs, brief councillors re draft CMP, meet with state government agencies re draft CMP and their responsibilities. Also engage with stakeholders via council advisory committee networks (e.g. Lower Hawkesbury Estuary Management Committee)
4.2 Increased awareness about funding options and how CMP implementation will be integrated with council's Resourcing Strategy and Delivery Program under IP&R	Council	Inform, Consult	Recognition of multiple funding sources for the coastal zone and upper catchments. Identification of integration into council IP&R planning and operations. Recognition of funding and resourcing limitations.	Use internal council working groups to facilitate and raise awareness of funding options and integration of the CMP within council's IP&R framework
4.3 Public authorities accept roles and responsibilities in the CMP	State government and other public authorities	Involve, Collaborate	Determination of cost apportionment across responsible public authorities	Link with state government agency meetings in Strategy 4.1

STAGE 5 ENGAGEMENT STRATEGIES

Engagement outcomes	Stakeholders	IAP2 Spectrum	Content & messages	Methods
5.1 Community understanding of how CMP will be implemented through the IP&R framework and land use planning system; and by other public authorities	Community, IRGs	Involve, Collaborate	Outline integration with council IP&R framework and roles and responsibilities for council and public authorities. Stress shared responsibility and that all are involved e.g. behaviour change	Fact sheets on council and project websites, use Council community networks and newsletters, return information sessions to high risk community groups (e.g. those in Strategy 2.4) continued dialogue with IRGs
5.2 Community informed about progress on actions	Community, IRGs	Inform	Community initiative – the need to continue to work together on actions	Progress information on council and project websites, use Council community networks and newsletters. Media releases and social media on progress. Letters to high risk community groups re progress on actions
5.3 Community is aware of the effectiveness of actions in terms of changes to coastal risk profile, coastal condition and community satisfaction	Community, IRGs	Inform, Involve	Reporting measured improvements	Involve communities in monitoring actions e.g. via citizen science Prepare and disseminate 'report cards' on the effectiveness of actions e.g. via project website, presentations to community groups.

5.4 Continue partnership with community by creating opportunities for community involvement in implementing, monitoring, evaluating and reporting CMP effectiveness	Community, IRGs	Involve, Collaborate, Empower	Communities can be involved in implementing and MER.	Involve communities in monitoring actions e.g. via citizen science. Continue dialogue with IRGs on their involvement, use community reference groups for large projects
5.5 Maintain and enhance partnerships across public authorities and also to seek opportunities to leverage off other programs (e.g. MEMA)	State government and other public authorities	Involve, Collaborate, Empower	Importance of maintaining and enhancing partnerships	Use CMP governance structure to regularly meet with public authorities

LOGISTICS

This strategy uses the following engagement methods that need to be developed for the Hawkesbury River system CMP process:

1. Project website and interactive map so that people can pin their risks, concerns and other comments (e.g. identify values and opportunities)
2. Internal working groups within each council for the development and implementation of the CMP
3. Community reference groups for large projects (Stage 5).

However, the use of existing networks and engagement methods, especially between councils and their communities, is encouraged throughout the engagement for each CMP stage. These include community advisory groups, youth advisory groups and business partnerships. Some events that can be used include:

- World Environment Day (June)
- Australia Day (January)
- Hawkesbury River Day
- Central Coast Harvest Festival (June)
- Oyster Festival (Ettalong- November)
- Festival on the Green (May)
- Wildflower Festival (September – St Ives)
- Hawkesbury Show (May)
- Hawkesbury Festival (June-July)
- Bridge to Bridge race

Venues to display information and hold meetings include:

- Coastal Environment Centre (Narrabeen)
- NPWS Interpretive Centres (Bobbin Head, West Head)
- Rumbalara Environmental Education Centre (Gosford)
- Gibberagong Environmental Education Centre (Bobbin Head)

Opportunities to partner with commercial operators and tour companies should be investigated to promote messaging flowing from the CMP (e.g. Riverboat).

RESPONSIBILITIES

The partner councils will be responsible for the delivery of each stage of this Strategy. They may devolve some of the engagement activities to consultants and other stakeholders e.g. DPIE.

EVALUATION

Evaluation of this engagement strategy is most important. Evaluation should be conducted during and at the end of each stage of the CMP process by the partnering councils.

A template to evaluate the engagement strategies is provided below.

What success looks like for:	The project team	The decision maker	The stakeholders

Evaluation strategy	How we will measure	Who will do it
How successful was the engagement?		
What could we do better?		
What did we learn?		

APPENDIX B
OVERVIEW OF EXISTING KNOWLEDGE AND DATA

Data / Document Information						Study Area Application					Technical Components					Coastal Vulnerability Area			Management			Values, threats,	
Data/Document Location	Dataset / Document Name	Author	Year	Data / Document Type	Spatial Scale	Upper Hawkesbury	Lower Hawkesbury	Pittwater	Brisbane Water	Broken Bay	Env - Physical	Env - Ecological	Social / Cultural	Economic	Stakeholder / Community Engagement	Inundation / SLR	Erosion / Recession	Cliff / Slope Instability	Actions	Responsibilites	Strategic Planning	Values	Threats / Risks
Local / Central Coast	Brisbane Water Estuary Processes Study	Cardno Lawson Treloar	2008	Technical Study	Estuary-Scale				✓		✓	✓	✓		✓	✓						✓	✓
Local / Central Coast	Brisbane Water Estuary Management Study	Cardno Lawson Treloar	2010	Management Study	Estuary-Scale				✓		✓	✓	✓		✓	✓						✓	✓
Local / Central Coast	Brisbane Water Foreshore Flood Study	Cardno	2013	Issues Study	Estuary-Scale				✓														
Local / Central Coast	Brisbane Water Estuary Coastal Zone Management Plan	Cardno	2012	Coastal / Estuary Management Plan	Estuary-Scale				✓		✓	✓	✓						✓	✓			✓
Local / Central Coast	Brisbane Water Public Wharves and Boat Ramps Usage Study	Cardno	2013	Technical Study	Estuary-Scale				✓				✓		✓					✓		✓	
Local / Central Coast	Open Coast and Broken Bay Beaches Hazard Definition Study	Worley Parsons	2014	Technical Study	Sub-LGA					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Local / Central Coast	Open Coast and Broken Bay Beaches Coastal Zone Management Study	Worley Parsons	2015	Technical Study	Sub-LGA					✓					✓	✓	✓	✓					
Local / Central Coast	Open Coast and Broken Bay Beaches Coastal Zone Hazard Mapping	Worley Parsons	2015	Mapping	LGA-Wide					✓						✓	✓	✓					
Local / Central Coast	Gosford Beaches Coastal Zone Management Plan	Worley Parsons	2017	Coastal / Estuary Management Plan	Sub-LGA					✓					✓				✓	✓		✓	✓
Local / Central Coast	Coastal Zone Management Plan for Pearl Beach Lagoon	BMT WBM	2015	Coastal / Estuary Management Plan	Estuary-Scale					✓	✓	✓	✓	✓	✓								
Local / Central Coast	Gosford LEP	Gosford City Council	2014	Local Plan	LGA-Wide		✓		✓	✓										✓	✓		
Local / Central Coast	Gosford DCP	Gosford City Council	2013	Local Plan	LGA-Wide		✓		✓	✓										✓	✓		
Local / Central Coast	Community Strategic Plan 2018-2028	Central Coast Council	2018	Local Plan	LGA-Wide		✓		✓	✓									✓	✓	✓	✓	
Local / Central Coast	Community Strategic Plan Framework 2018-2028	Central Coast Council	2018	Local Plan	LGA-Wide		✓		✓	✓									✓	✓	✓	✓	
Local / Central Coast	Delivery Program and Operational Plan 2018-19	Central Coast Council	2018	Local Plan	LGA-Wide		✓		✓	✓									✓	✓	✓	✓	
Local / Central Coast	Central Coast Council Resourcing Strategy 2018-2028	Central Coast Council	2018	Local Plan	LGA-Wide		✓		✓	✓										✓	✓		
Local / Central Coast	Brisbane Water Sea Level Rise and Ocean Inundation Mapping	Gosford City Council	2014	Mapping	Estuary-Scale				✓		✓	✓				✓							
Local / Central Coast	Mudflat Creek Killcare Flood Study	WMA	2006	Technical Study	Sub-LGA				✓		✓					✓			✓	✓		✓	✓
Local / Central Coast	Mudflat Creek Floodplain Risk Management Study	WMA	2008	Management Study	Sub-LGA				✓		✓	✓	✓	✓									
Local / Central Coast	Turo Creek, Pretty Beach Floodplain Risk Management Plan	Cardno Lawson Treloar	2007	Local Plan	Sub-LGA				✓		✓	✓	✓	✓	✓	✓			✓	✓			✓
Local / Central Coast	Brisbane Water Foreshore Floodplain Risk Management Plan	Cardno	2015	Local Plan	Estuary-Scale				✓		✓	✓	✓	✓	✓	✓			✓	✓			✓
Local / Central Coast	Erina Creek Floodplain Risk Management Study and Plan	WMA	2015	Local Plan	Sub-LGA				✓				✓		✓	✓			✓	✓			
Local / Central Coast	Brisbane Water Overland Flood Study	Cardno	2019	Technical Study	Estuary-Scale				✓		✓					✓			✓	✓			✓
Local / Central Coast	East Gosford Catchment Study	Bewsher Consulting	1995	Technical Study	Sub-LGA				✓		✓					✓			✓	✓			✓
Local / Central Coast	Wagstaffe Drainage Study	Ivan Tye & Associates	2000	Technical Study	Sub-LGA				✓		✓					✓			✓	✓			✓
Local / Central Coast	Pearl Beach Lagoon Condition Study and Community Uses Report	BMT WBM	2015	Technical Study	Estuary-Scale					✓	✓	✓	✓		✓							✓	✓
Local / Central Coast	Foreshore Parks Plan of Management	Gosford City Council	1996	Local Plan	LGA-Wide				✓	✓										✓			
Local / Central Coast	Yattalunga Foreshore Reserve Plan of Management	Context Landscape Design / Conybeare Morrison & Partners	2001	Local Plan	Sub-LGA				✓											✓			
Local / Central Coast	Gosford Foreshore Plan of Management	Gosford City Council	2004	Local Plan	Sub-LGA				✓											✓			
Local / Central Coast	Gosford Health of the Waterways Report 2015	Gosford City Council	2015	Technical Study	Estuary-Scale		✓		✓	✓	✓	✓											✓
Local / Central Coast	Peat Island and Mooney Mooney Rezoning Report	Urbis	2014	Local Plan	Sub-LGA			✓			✓	✓	✓	✓	✓								
Local / Northern Beache	Pittwater Coastal Management Program Scoping Study – Issues Paper	Rhelm	2018	Technical Study	Estuary-Scale			✓			✓	✓	✓	✓					✓	✓		✓	✓
Local / Northern Beache	Pittwater Waterway Review - Stage 1 Discussion Paper	Northern Beaches Council	2017	Technical Study	Estuary-Scale			✓															
Local / Northern Beache	Water quality monitoring as part of Monitoring & Evaluation Reporting (MER)	Numrous Councils and Sydney Water	2017	Technical Study	Estuary-Scale			✓			✓	✓				✓							✓
Local / Northern Beache	Pittwater Estuary - Mapping of Sea Level Rise Impacts	Cardno	2015	Mapping	Estuary-Scale			✓															
Local / Northern Beache	Pittwater Waterbird Habitat Survey and Mapping	Brandis et al.	2012	Technical Study	Estuary-Scale			✓				✓				✓							
Local / Northern Beache	Pittwater Heritage Study	City Plan Services	2012	Technical Study	LGA-Wide			✓					✓						✓	✓			
Local / Northern Beache	Assessment of future anthropogenic change and associated benthic risk in coastal environments using sedimentary metal indicators	Birch et al.	2012	Technical Study	Non-Spatial			✓			✓	✓											✓
Local / Northern Beache	Sand Point Boat Ramp – Climate Change Impact Assessment	MHL	2012	Technical Study	Sub-LGA			✓			✓		✓										
Local / Northern Beache	NSW Boat Ownership and Storage Report	NSW Maritime	2010	Technical Study	State	✓	✓	✓	✓	✓			✓						✓	✓		✓	
Local / Northern Beache	Estuarine habitat mapping and geomorphic characterisation of the lower Hawkesbury river and Pittwater estuaries	Astles et al. (DPI)	2010	Technical Study	Estuary-Scale			✓			✓	✓										✓	✓
Local / Northern Beache	Pittwater Estuary Management Plan	BMT WBM	2010	Coastal / Estuary Management Plan	Estuary-Scale			✓			✓	✓	✓	✓	✓	✓			✓	✓		✓	✓
Local / Northern Beache	Pittwater Estuary Management Study	BMT WBM	2006	Technical Study	Estuary-Scale			✓			✓	✓	✓	✓	✓				✓	✓		✓	✓
Local / Northern Beache	Pittwater Estuary Processes Study	Lawson & Treloar	2002	Management Study	Estuary-Scale			✓			✓	✓	✓			✓						✓	✓
Local / Northern Beache	Pittwater Waterway Issues of Concern	Australian Water & Coastal Studies	1996	Technical Study	Estuary-Scale			✓			✓	✓	✓									✓	✓
Local / Northern Beache	Pittwater Waterway Estuary Data Compilation Study	Australian Water & Coastal Studies	1996	Technical Study	Estuary-Scale			✓			✓	✓											
Local / Northern Beache	Storage of watercraft on council foreshores policy	Northern Beaches Council	2017	Policy	LGA-Wide			✓															
Local / Northern Beache	Scotland Island emergency water pipeline and non-potable water Supply Policy	Northern Beaches Council	2017	Policy	LGA-Wide			✓											✓	✓		✓	✓
Local / Northern Beache	Disability Inclusion Action Plan 2017-2021	Northern Beaches Council	2017	Local Plan	LGA-Wide			✓					✓		✓				✓	✓			

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Data/Document Location	Dataset / Document Name	Author	Year	Data / Document Type	Spatial Scale	Upper Hawkesbury	Lower Hawkesbury	Pittwater	Brisbane Water	Broken Bay	Env - Physical	Env - Ecological	Social / Cultural	Economic	Stakeholder / Community Engagement	Inundation / SLR	Erosion / Recession	Cliff / Slope Instability	Actions	Responsibilites	Strategic Planning	Values	Threats / Risks
Local / Northern Beache	Community Engagement Policy	Northern Beaches Council	2017	Policy	LGA-Wide			✓					✓						✓	✓			
Local / Northern Beache	Beach Parking Permit Policy	Northern Beaches Council	2017	Policy	LGA-Wide			✓					✓						✓	✓			
Local / Northern Beache	SHAPE 2028 Northern Beaches Draft Community Strategic Plan 2017-2028	Northern Beaches Council	2017	Local Plan	LGA-Wide			✓					✓	✓					✓	✓	✓	✓	
Local / Northern Beache	Northern Beaches Council Resourcing Strategy 2018 – 2028	Northern Beaches Council	2018	Local Plan	LGA-Wide			✓													✓		
Local / Northern Beache	Northern Beaches Council Delivery Program 2019-2023	Northern Beaches Council	2019	Local Plan	LGA-Wide			✓													✓		
Local / Northern Beache	Northern Beaches Council Operational Plan 2019/20	Northern Beaches Council	2019	Local Plan	LGA-Wide			✓													✓		
Local / Northern Beache	Pittwater Stormwater Management Strategy 2015-2019	Pittwater Council	2015	Local Plan	Estuary-Scale			✓											✓	✓			
Local / Northern Beache	Climate Change Policy (Policy No 176)	Pittwater Council	2015	Policy	LGA-Wide			✓			✓	✓	✓	✓					✓	✓			
Local / Northern Beache	Coastline Risk Management Policy for Development in Pittwater	Pittwater Council	2014	Policy	LGA-Wide			✓								✓			✓	✓			
Local / Northern Beache	Estuarine Risk Management Policy for Development in Pittwater	Pittwater Council	2014	Policy	LGA-Wide			✓								✓			✓	✓			
Local / Northern Beache	Pittwater Public Space and Recreation Strategy 2014	Pittwater Council	2014	Local Plan	LGA-Wide			✓					✓	✓					✓	✓			
Local / Northern Beache	Pittwater LEP	Pittwater Council	2014	Local Plan	LGA-Wide			✓												✓	✓		
Local / Northern Beache	Pittwater DCP	Pittwater Council	2014	Local Plan	LGA-Wide			✓												✓	✓		
Local / Northern Beache	Watercourse Preservation Policy	Pittwater Council	2013	Policy	LGA-Wide			✓											✓	✓			
Local / Northern Beache	Dog Control Policy	Pittwater Council	2013	Policy	LGA-Wide			✓					✓						✓	✓			
Local / Northern Beache	Risk Management Policy for Coastal Public Buildings and Assets in Pittwater	Pittwater Council	2013	Policy	LGA-Wide			✓											✓	✓			
Local / Northern Beache	Reserves Beaches and Headlands Booking Policy (No 93)	Pittwater Council	2013	Policy	LGA-Wide			✓											✓	✓			
Local / Northern Beache	Pittwater Native Vegetation Management Plan	Pittwater Council	2012	Local Plan	LGA-Wide			✓			✓	✓							✓	✓			
Local / Northern Beache	Integrated water cycle management policy (No 194)	Pittwater Council	2012	Policy	LGA-Wide			✓				✓							✓	✓			
Local / Northern Beache	Native fauna management plan for the Pittwater Local Government Area	Pittwater Council	2011	Local Plan	LGA-Wide			✓			✓	✓							✓	✓			
Local / Northern Beache	Greywater reuse for sewered and unsewered domestic premises (Policy 156)	Pittwater Council	2011	Policy	LGA-Wide			✓											✓	✓			
Local / Northern Beache	Pittwater local planning strategy planning Pittwater towards 2031	Pittwater Council	2011	Local Plan	LGA-Wide			✓					✓	✓					✓	✓			
Local / Northern Beache	Beach and Rockpool Management Policy (No 88)	Pittwater Council	2011	Policy	LGA-Wide			✓					✓						✓	✓			
Local / Northern Beache	Woorak Reserve, Iluka Road and Sandy Point Lane Plan of Management	Pittwater Council	2010	Local Plan	Sub-LGA			✓					✓						✓	✓			
Local / Northern Beache	Geotechnical Risk Management Policy	Pittwater Council	2013	Policy	LGA-Wide			✓			✓					✓			✓	✓			
Local / Northern Beache	Pittwater Natural Areas Plan of Management (Part 1 of 2: Generic Management Issues, Part 2 of 2: Reserve Chapters)	Pittwater Council/Land and Property Management Authority	2009	Local Plan	LGA-Wide			✓			✓	✓							✓	✓			
Local / Northern Beache	Church Point Sydney Plan of Management	Pittwater Council/Land and Property Management Authority	2009	Local Plan	Sub-LGA			✓					✓						✓	✓			
Local / Northern Beache	Public Wharves Pittwater Plan of Management	Pittwater Council	2008	Local Plan	Estuary-Scale			✓					✓						✓	✓			
Local / Northern Beache	Snapperman Beach Reserve - Palm Beach Plan of Management	Pittwater Council	2006	Local Plan	Sub-LGA			✓					✓						✓	✓			
Local / Northern Beache	Winnererremy Bay Plan of Management	Pittwater Council	2003	Local Plan	Sub-LGA			✓					✓						✓	✓			
Local / Northern Beache	Governor Phillip Park Plan of Management	Pittwater Council	2002	Local Plan	Sub-LGA			✓					✓						✓	✓			
Local / Northern Beache	Urban Bushland Inventory and Action Plan - Volume 2 North Ward Reserves	Pittwater Council	1998	Local Plan	Sub-LGA			✓				✓							✓	✓			
Local / Northern Beache	Careel Bay Wetlands Plan of Management	Pittwater Council	1998	Local Plan	Sub-LGA			✓				✓							✓	✓			
Local / Northern Beache	Helicopter landings on council owned and controlled property policy (No 98)	Pittwater Council	1997	Policy	LGA-Wide			✓					✓						✓	✓			
Local / Northern Beache	Habitat and wildlife corridors - A conservation strategy	Pittwater Council	1995	Local Plan	LGA-Wide			✓			✓	✓							✓	✓			
Local / Northern Beache	Pittwater Waterway Review - The Strategy 2038	Northern Beaches Council	2018	Local Plan	Estuary-Scale			✓			✓	✓	✓	✓					✓	✓		✓	✓
Local / Northern Beache	Pittwater Estuary Planning Levels	Cardno	2011	Mapping	Estuary-Scale			✓			✓					✓							✓
Local / Northern Beache	Pittwater Estuary Planning Level Reduction Factors	Cardno	2016	Technical Study	Estuary-Scale			✓			✓					✓			✓	✓			✓
Local / Northern Beache	Urban Bushland Inventory and Action Plan - Volume 2 Central Ward Reserves	Pittwater Council	1998	Local Plan	LGA-Wide			✓			✓	✓	✓						✓	✓			
Local / Northern Beache	Urban Bushland Plan of Management	Pittwater Council	1996	Local Plan	LGA-Wide			✓											✓	✓			
Local / Northern Beache	Urban Bushland Inventory and Action Plan - Volume 2 South Ward Reserves	Pittwater Council	1998	Local Plan	LGA-Wide			✓											✓	✓			
Local / Northern Beache	Pittwater Park Draft Plan of Management - Barrenjoey Road Palm Beach	Pittwater Council	2002	Local Plan	Sub-LGA			✓											✓	✓			
Local / Northern Beache	McKay Reserve and Dark Gully Park - Plan of Management	Pittwater Council	2001	Local Plan	Sub-LGA			✓											✓	✓			
Local / Northern Beache	Habitat and Wildlife Corridors - A Conservation Strategy	Pittwater Council	1995	Local Plan	LGA-Wide			✓				✓							✓	✓		✓	✓
Local / Northern Beache	Water Efficiency Plan	Pittwater Council	2012	Local Plan	LGA-Wide			✓											✓	✓			
Local / Northern Beache	Pittwater 2025 - Our Community Strategic Plan	Pittwater Council	2013	Local Plan	LGA-Wide			✓					✓	✓					✓	✓		✓	
Local / Northern Beache	Coastal Process Study - Resolute Beach to the Basin - Pittwater	NSW Institute of Technology	1985	Technical Study	Estuary-Scale			✓			✓												

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Data/Document Location	Dataset / Document Name	Author	Year	Data / Document Type	Spatial Scale	Upper Hawkesbury	Lower Hawkesbury	Pittwater	Brisbane Water	Broken Bay	Env - Physical	Env - Ecological	Social / Cultural	Economic	Stakeholder / Community Engagement	Inundation / SLR	Erosion / Recession	Cliff / Slope Instability	Actions	Responsibilites	Strategic Planning	Values	Threats / Risks
Local / Northern Beaches	Great Mackerel Beach Entrance Management Strategy	MHL	2017	Local Plan	Sub-LGA			✓			✓	✓	✓						✓	✓		✓	✓
Local / Northern Beaches	McCarrs Creek, Mona Vale and Bayview Flood Study	Royal HaskoningDHV	2017	Technical Study	Sub-LGA			✓			✓	✓							✓	✓		✓	✓
Local / Northern Beaches	New South Wales Community Perceptions of Coastal Erosion and Inundation	UNSW	2019	Technical Study	State	✓	✓	✓	✓	✓	✓		✓		✓								
Local / Northern Beaches	An analysis of changes to aquatic habitats and adjacent land-use in the downstream portion of the Hawkesbury Nepean River over the past sixty years	NSW DPI	2007	Technical Study	Estuary-Scale	✓	✓	✓	✓	✓		✓											
Local / Northern Beaches	Fluctuations and Shoreline Change	Gordon, A.D.	1987	Technical Study	LGA-Wide			✓			✓												
Local / Northern Beaches	Sea Level Rise - more location specific mapping	CoastAdapt	2018	Technical Study	Estuary-Scale			✓			✓												
Local / Northern Beaches	Beach Scraping Asessment for Sandy Beach	WRL	2019	Technical Study	Sub-LGA			✓			✓	✓	✓										
Local / Northern Beaches	Advice on Management of Erosion at Sandy Beach	Royal Haskoning	2015	Technical Study	Sub-LGA			✓			✓	✓	✓						✓	✓			
Local / Northern Beaches	Coastal Engineering Advice on Sandy Beach at Palm Beach	Horton Coastal Engineering	2017	Technical Study	Sub-LGA			✓			✓												
Local / Northern Beaches	Coastal Engineering Advice on Paradise Beach at Avalon	Horton Coastal Engineering	2016	Technical Study	Sub-LGA			✓			✓												
Local / Hornsby Shire	Community Strategic Plan 2018-2028	Hornsby Shire Council	2018	Local Plan	LGA-Wide		✓						✓	✓					✓	✓	✓	✓	
Local / Hornsby Shire	Community Strategic Plan Framework 2018-2028	Hornsby Shire Council	2018	Local Plan	LGA-Wide		✓						✓	✓					✓	✓	✓	✓	
Local / Hornsby Shire	Delivery Program and Operational Plan 2018-19	Hornsby Shire Council	2018	Local Plan	LGA-Wide		✓													✓	✓		
Local / Hornsby Shire	Long Term Financial Plan 2014-2024	Hornsby Shire Council	2014	Local Plan	LGA-Wide		✓													✓	✓		
Local / Hornsby Shire	Resourcing Strategy 2013 and Asset Management Framework 2016	Hornsby Shire Council	2013	Local Plan	LGA-Wide		✓													✓	✓		
Local / Hornsby Shire	Hornsby DCP	Hornsby Shire Council	2013	Local Plan	LGA-Wide		✓													✓	✓		
Local / Hornsby Shire	Hornsby LEP	Hornsby Shire Council	2013	Local Plan	LGA-Wide		✓													✓	✓		
Local / Hornsby Shire	Modelling and Mapping of Coastal Inundation under Future Sea Level Rise	CSIRO	2011	Mapping	Regional		✓				✓					✓							✓
Local / Hornsby Shire	Modelling and Mapping of Coastal Inundation under Future Sea Level Rise Report for Sydney Coastal Councils Group	CSIRO	2011	Technical Study	Regional		✓				✓					✓							✓
Local / Hornsby Shire	Catchments Remediation Rate Program and Annual Report	Hornsby Shire Council	2015	Technical Study	Regional		✓				✓	✓											
Local / Hornsby Shire	Water Quality Program:	Hornsby Shire Council	2019	Technical Study	Sub-LGA		✓																
Local / Hornsby Shire	Lower Hawkesbury Estuary Management Plan	BMT WBM	2008	Coastal / Estuary Management Plan	Estuary-Scale		✓				✓	✓	✓	✓	✓				✓	✓		✓	✓
Local / Hornsby Shire	Water Sensitive Hornsby Strategy	Hornsby Shire Council	2019	Local Plan	LGA-Wide		✓												✓	✓			
Local / Hornsby Shire	Berowra Creek Estuary Management Study and Plan	WMA	2003	Coastal / Estuary Management Plan	Sub-LGA		✓				✓	✓	✓	✓	✓				✓	✓		✓	✓
Local / Hornsby Shire	Berowra Creek Estuary Management Plan Review	BMT WBM	2007	Technical Study	Sub-LGA		✓					✓										✓	✓
Local / Hornsby Shire	Berowra Creek Estuary Processes Study – Sediment Characteristics and Processes	CMGGEC	1998	Technical Study	Sub-LGA		✓				✓											✓	
Local / Hornsby Shire	Berowra Creek Estuary Processes Study Aquatic Ecological Investigations	The Ecology Lab	1998	Technical Study	Sub-LGA		✓					✓										✓	✓
Local / Hornsby Shire	Berowra Creek Estuary Processes Study Review and Interpretation of Existing Data	MHL	1998	Technical Study	Sub-LGA		✓				✓	✓										✓	
Local / Hornsby Shire	Berowra Creek Estuary Processes Study Estuarine Water Quality	MHL	1998	Technical Study	Sub-LGA		✓				✓											✓	✓
Local / Hornsby Shire	Berowra Catchment Economic Scoping Study	DLWC	1997	Technical Study	Sub-LGA		✓							✓								✓	
Local / Hornsby Shire	Brooklyn Estuary Management Study	WRL	2006	Management Study	Sub-LGA		✓				✓	✓	✓	✓	✓				✓	✓		✓	✓
Local / Hornsby Shire	Brooklyn Estuary Management Plan	WBM	2006	Coastal / Estuary Management Plan	Sub-LGA		✓								✓				✓	✓		✓	✓
Local / Hornsby Shire	Brooklyn Estuary Process Study	WBM	2003	Technical Study	Sub-LGA		✓																
Local / Hornsby Shire	Environmental Sustainability Strategy	Hornsby Shire Council	2019	Local Plan	LGA-Wide		✓												✓	✓			
Local / Hornsby Shire	Climate Change Adaptation DCP criteria	Hornsby Shire Council	2019	Local Plan	LGA-Wide		✓												✓	✓			
Local / Hornsby Shire	Biodiversity Management Plan	Hornsby Shire Council	2019	Local Plan	LGA-Wide		✓												✓	✓			
Local / Hornsby Shire	Hawkesbury-Nepean Valley Regional Flood Study Final Draft Report	WMA	2019	Technical Study	Estuary-Scale	✓	✓				✓	✓											
Local / Hornsby Shire	Independent Inquiry into the Hawkesbury Nepean River System	Healthy Rivers Commission of New South Wales	1998	Technical Study	Regional	✓	✓	✓	✓	✓									✓	✓		✓	✓
Local / Hornsby Shire	Biological Monitoring program for Berowra Creek Estuary	ACU	2005	Technical Study	Sub-LGA		✓				✓	✓											
Local / Hornsby Shire	Guidelines to management response to freshwater and estuarine HABs	Water NSW	2018	Technical Study	Non-Spatial	✓	✓	✓	✓	✓	✓	✓	✓						✓	✓		✓	✓
Local / Hornsby Shire	NSW Shellfish Program Marine Biotoxin management plan	NSW Food Authority	2014	State Plan	State	✓	✓	✓	✓	✓		✓	✓	✓					✓	✓			
Local / Hornsby Shire	MoU between Broken Bay Oysters Assoc and HSC	Hornsby Shire Council	2015	Regional Plan	Estuary-Scale		✓			✓		✓	✓						✓	✓			
Local / Hornsby Shire	Social & Economic Evaluation of NSW Coastal Aquaculture	UTS	2017	Technical Study	State	✓	✓	✓	✓	✓		✓	✓	✓						✓		✓	✓
Local / Hornsby Shire	Social & Economic Evaluation of NSW Coastal professional Wild Catch Fishers	UTS	2017	Technical Study	State	✓	✓	✓	✓	✓		✓	✓	✓						✓		✓	✓
Local / Hornsby Shire	The Hawkesbury-Nepean River Environmental Monitoring Program	DECC	2009	State Plan	Estuary-Scale	✓	✓				✓	✓								✓		✓	✓
Local / Hornsby Shire	Hornsby Shire Waterways Review	SJB Planning	2009	Technical Study	LGA-Wide		✓												✓	✓			

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Local / Hornsby Shire	Hornsby Shire River Settlements and Foreshores Review	SJB Planning	2007	Technical Study	LGA-Wide		✓				✓	✓							✓				
Local / Hornsby Shire	Hornsby priority creeks study	Alluvium	2017	Technical Study	LGA-Wide		✓				✓	✓							✓		✓	✓	
Local / Hornsby Shire	Saltmarsh restoration in Brooklyn	Hornsby Shire Council	2006	Technical Study	Sub-LGA		✓				✓	✓							✓				
Local / Hornsby Shire	Hawkesbury River Estuary Economic Benefit Identification Study	Rolyat Services Pty Ltd	2013	Technical Study	Estuary-Scale		✓	✓	✓	✓			✓	✓								✓	
Local / Hornsby Shire	Estuarine Bird Survey, 2012	P & J Smith Ecological Consultants	2012	Technical Study	Estuary-Scale		✓					✓											
Local / Hornsby Shire	Vulnerability assessment of the effects of climate change on estuarine habitats in the Lower Hawkesbury estuary	DPI Fisheries	2012	Technical Study	Estuary-Scale		✓					✓							✓			✓	
Local / Hornsby Shire	Estuarine habitat mapping and geomorphic characterisation of the Lower Hawkesbury Estuary river and Pittwater estuaries	DPI Fisheries	2010	Mapping	Estuary-Scale		✓				✓	✓											
Local / Hornsby Shire	Riverbank vulnerability assessment of the Lower Hawkesbury	WRL	2014	Technical Study	Estuary-Scale		✓				✓					✓			✓				
Local / Hornsby Shire	Sediment and Antifoul Study Final Report	Geochemical Assessments	2014	Technical Study	Estuary-Scale		✓																
Local / Hornsby Shire	2018 Clean4Shore program Report	Clean4Shore	2018				✓		✓														
Local / Ku-ring-gai	Community Strategic Plan 2038	Ku-ring-gai Council	2018	Local Plan	LGA-Wide		✓						✓	✓					✓	✓	✓	✓	
Local / Ku-ring-gai	Asset Management Strategy 2018-2028	Ku-ring-gai Council	2018	Local Plan	LGA-Wide		✓						✓	✓					✓	✓	✓	✓	
Local / Ku-ring-gai	Delivery Program and Operational Plan 2018-21	Ku-ring-gai Council	2018	Local Plan	LGA-Wide		✓													✓	✓		
Local / Ku-ring-gai	Long Term Financial Plan 2018-2028	Ku-ring-gai Council	2018	Local Plan	LGA-Wide		✓													✓	✓		
Local / Ku-ring-gai	Resourcing Strategy 2018-2028	Ku-ring-gai Council	2018	Local Plan	LGA-Wide		✓												✓	✓	✓		
Local / Ku-ring-gai	Ku-ring-gai Stream Health Monitoring	Ku-ring-gai Council	2018	Technical Study	LGA-Wide		✓																
Local / Ku-ring-gai	Lovers Jump Creek Flood Study Review	Jacobs	2018	Technical Study	Sub-LGA		✓				✓					✓							
Local / Ku-ring-gai	Lovers Jump Creek Floodplain Risk Management Study and Plan	Jacobs	2019	Local Plan	Sub-LGA		✓				✓	✓	✓	✓	✓	✓			✓	✓		✓	✓
Local / Ku-ring-gai	Ku-ring-gai Biodiversity & Riparian Lands Study Version 5	Ku-ring-gai Council	2016	Technical Study	LGA-Wide		✓				✓	✓	✓	✓		✓							
Local / Ku-ring-gai	Cowan Creek Catchments Subcatchment Stormwater analysis and planning	Brown	2004	Technical Study	Sub-LGA		✓				✓	✓											
Local / Ku-ring-gai	Ku-ring-gai DCP	Ku-ring-gai Council	2015	Local Plan	LGA-Wide		✓													✓	✓		
Local / Ku-ring-gai	Ku-ring-gai LEP	Ku-ring-gai Council	2015	Local Plan	LGA-Wide		✓													✓	✓		
Local / Ku-ring-gai	Ku-ring-gai Creek Catchment Study Final	Equatica	2012	Local Plan	LGA-Wide		✓				✓	✓											
Local / Hawkesbury City	Hawkesbury DCP	Hawkesbury City Council	2002	Local Plan	LGA-Wide	✓														✓	✓		
Local / Hawkesbury City	Hawkesbury LEP	Hawkesbury City Council	2012	Local Plan	LGA-Wide	✓														✓	✓		
Local / Hawkesbury City	Community Strategic Plan 2017-2036	Hawkesbury City Council	2017	Local Plan	LGA-Wide	✓															✓		
Local / Hawkesbury City	Resourcing Strategy 2017-2027	Hawkesbury City Council	2017	Local Plan	LGA-Wide	✓															✓		
Local / Hawkesbury City	Delivery Program and Operational Plan 2017-21	Hawkesbury City Council	2019	Local Plan	LGA-Wide	✓															✓		
Local / Hawkesbury City	Upper Hawkesbury Estuary CZMP - Stage 1 Synthesis Report	BMT WBM	2013	Technical Study	Estuary-Scale	✓					✓	✓	✓	✓					✓	✓		✓	✓
Local / Hawkesbury City	Upper Hawkesbury Estuary Community Consultation Report	BMT WBM	2013	Technical Study	Estuary-Scale	✓							✓		✓								
Local / Hawkesbury City	Upper Hawkesbury Estuary Coastal Zone Management Plan	BMT WBM	2014	Coastal / Estuary Management Plan	Estuary-Scale	✓					✓	✓	✓	✓	✓	✓			✓	✓		✓	✓
Local / Hawkesbury City	Upper Hawkesbury Estuary Bank Erosion, Foreshore Structure & Weed Mapping Report	BMT WBM	2013	Technical Study	Estuary-Scale	✓					✓	✓				✓							
Local / Hawkesbury City	Lower Macdonald Flood Study 2004	WMA	2004	Technical Study	Sub-LGA	✓					✓					✓							
Local / Hawkesbury City	Hawkesbury City Council Planning for Climate and Natural Hazards - Risk Assessment Report	GHD	2012	Technical Study	LGA-Wide	✓					✓	✓	✓	✓		✓							✓
Local / Hawkesbury City	Hawkesbury City Council Adaptation Action Plan - Planning for Climate and Natural Hazards	Cardno	2016	Local Plan	LGA-Wide	✓					✓	✓	✓	✓									✓
Local / Hawkesbury City	Hawkesbury Floodplain Risk Management Study and Plan	Bewsher Consulting	2012	Regional Plan	Regional	✓	✓				✓			✓	✓	✓			✓	✓		✓	✓
Local / Hawkesbury City	Hawkesbury Floodplain Risk Management Study and Plan - Associated Mapping	Bewsher Consulting	2012	Mapping	Regional	✓	✓				✓					✓							✓
Local / Hills	Hills DCP	Hills Council	2012	Local Plan	LGA-Wide	✓														✓	✓		
Local / Hills	Hills LEP	Hills Council	2012	Local Plan	LGA-Wide	✓														✓	✓		
Local / Hills	The Hills Future 2017-2021 Community Strategic Plan	Hills Council	2017	Local Plan	LGA-Wide	✓														✓	✓		
Local / Hills	The Hills Shire Council 2017-2021 Resourcing Strategy	Hills Council	2017	Local Plan	LGA-Wide	✓														✓	✓		
Local / Hills	The Hills Shire Council 2017-2021 Delivery Program	Hills Council	2017	Local Plan	LGA-Wide	✓														✓	✓		
Local / Hills	The Hills Shire Council 2019-2020 Operational Plan	Hills Council	2017	Local Plan	LGA-Wide	✓													✓	✓	✓		
Local / Hills	Sportsgrounds - Generic Plan of Management	Hills Council	2014	Local Plan	LGA-Wide	✓													✓	✓			
Local / Hills	Parkland Generic Plan of Management	Hills Council	2012	Local Plan	LGA-Wide	✓													✓	✓			
Local / Hills	General Community Use - Generic Plan of Management	Hills Council	2012	Local Plan	LGA-Wide	✓													✓	✓			
Local / Hills	Natural Areas - Plan of Management	Hills Council	2008	Local Plan	LGA-Wide	✓													✓	✓			
Local / Hills	Wetlands of Cattai Catchment	Cattai Catchment Management Committee	1999	Local Plan	Sub-LGA	✓					✓	✓	✓	✓					✓	✓		✓	✓
State Data and Plans	NSW2021	NSW Government	2011	State Plan	State	✓	✓	✓	✓	✓											✓	✓	
Local / Northern Beache	Hawkesbury Shelf Marine Bioregion Threat and Risk Assessment TARA Report	BMT WBM	2015	Technical Study	Regional	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓			
State Data and Plans	NSW Marine Estate Threat and Risk Assessment	BMT WBM	2016	Technical Study	State	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓			

Data / Document Information						Study Area Application					Technical Components					Coastal Vulnerability Area			Management			Values, threats,	
Data/Document Location	Dataset / Document Name	Author	Year	Data / Document Type	Spatial Scale	Upper Hawkesbury	Lower Hawkesbury	Pittwater	Brisbane Water	Broken Bay	Env - Physical	Env - Ecological	Social / Cultural	Economic	Stakeholder / Community Engagement	Inundation / SLR	Erosion / Recession	Cliff / Slope Instability	Actions	Responsibilites	Strategic Planning	Values	Threats / Risks
State Data and Plans	NSW Marine Estate Management Strategy: A Live	Aither	2019	Technical Study	State	✓	✓	✓	✓	✓	✓	✓											
State Data and Plans	Sydney Regional Environmental Plan No 20 - Hawkesbury-Nepean River 1997	NSW Government	1997	State Plan	Regional	✓	✓	✓												✓			
State Data and Plans	Risk based framework waterway health strategic land use planning 170205	OEH and EPA	2017	State Plan	State	✓	✓	✓	✓	✓	✓	✓	✓	✓								✓	
State Data and Plans	NSW Climate Change Policy Framework	NSW Government	2016	State Plan	State	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓		✓	
State Data and Plans	NSW Maritime Infrastructure Plan 2019-2024	NSW Government	2019	State Plan	State	✓	✓	✓	✓	✓			✓	✓	✓				✓	✓		✓	✓
State Data and Plans	NSW Coastal Dredging Strategy 2019 – 2024	NSW Government	2019	State Plan	State	✓	✓	✓	✓	✓									✓	✓			
State Data and Plans	NSW Regional Ports Strategy	NSW Government	2016	State Plan	State	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓		✓	
State Data and Plans	Sea Level Rise Science and Synthesis for NSW	NSW Government	2018	Technical Study	State	✓	✓	✓	✓	✓	✓					✓						✓	✓
State Data and Plans	NSW Oyster Industry Sustainable Aquaculture Strategy 2016	NSW Government	2016	State Plan	State	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓		✓	✓
State Data and Plans	Scheyville National Park and Pitt Town Nature Reserve Plan of Management	NSW Government	2000	Management Plan	State	✓					✓	✓	✓	✓						✓			
Regional Data and Plans	A Metropolis of Three Cities – the Greater Sydney Region Plan	NSW Government	2018	Regional Plan	Regional	✓	✓	✓		✓					✓				✓	✓	✓	✓	✓
Regional Data and Plans	Central Coast Regional Plan 2036	NSW Government	2017	Regional Plan	Regional		✓		✓	✓					✓				✓	✓	✓	✓	✓
Regional Data and Plans	Greater Sydney Local Land Services Local Strategic Plan 2016-2021	GS LLS	2016	Regional Plan	Regional	✓	✓	✓	✓	✓					✓				✓	✓		✓	✓
Regional Data and Plans	Hawkesbury-Nepean Catchment Action Plan 2013-2023	HNCMA	2013	Regional Plan	Regional	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓
Regional Data and Plans	Regional Boating Plan for Hawkesbury River, Pittwater and Brisbane Water Region 2015	RMS	2015	Regional Plan	Regional	✓	✓	✓	✓	✓			✓	✓	✓				✓	✓		✓	✓
Regional Data and Plans	Resilient Valley, Resilient Communities – Hawkesbury-Nepean Valley Flood Risk Management Strategy	iNSW	2017	Regional Plan	Regional	✓	✓				✓		✓	✓	✓	✓			✓	✓		✓	✓
Regional Data and Plans	Water Sharing Plan Greater Metropolitan Region Groundwater Sources	NSW Office of Water	2011	Regional Plan	Regional	✓	✓	✓		✓									✓	✓		✓	✓
Regional Data and Plans	The Hawkesbury Destination Management and Action Plan 2017-2021	Stafford	2017	Regional Plan	Regional	✓	✓	✓		✓									✓	✓		✓	
Regional Data and Plans	The 2017 Metropolitan Water Plan for Sydney	Metropolitan Water	2017	Regional Plan	Regional	✓	✓	✓		✓			✓	✓					✓	✓		✓	✓
Regional Data and Plans	Final Report for The Hawkesbury-Nepean River Environmental Monitoring Program	DECC	2009	Technical Study	Estuary-Scale	✓	✓				✓	✓	✓	✓								✓	✓
Regional Data and Plans	Analysis of long-term water quality for effective river health monitoring in peri-urban landscapes - A case study of the Hawkesbury–Nepean river system in NSW, Australia	Pinto et al	2012	Technical Study	Estuary-Scale	✓					✓	✓										✓	✓
Regional Data and Plans	Impacts of Water Quality on the Harvest of School Prawn (Metapenaeus macleayi) in a Peri-Urban River System	Pinto et al	2012	Technical Study	Estuary-Scale	✓	✓			✓	✓	✓	✓	✓								✓	✓
Regional Data and Plans	Common Riverbank Weeds of the Hawkesbury-Nepean River and Tributaries	GS LLS	2014	Technical Study	Estuary-Scale	✓	✓				✓	✓										✓	✓
Regional Data and Plans	An inventory of pollutant sources in the Hawkesbury-Nepean River catchment : technical report	NSW EPA	1993	Technical Study	Estuary-Scale	✓	✓				✓	✓							✓	✓		✓	✓
Regional Data and Plans	Bioregional Assessment project : Sydney Metropolitan, Southern Rivers and Hawkesbury-Nepean Catchment	Bradd et al	2012	Technical Study	Estuary-Scale	✓	✓				✓	✓							✓	✓		✓	✓
Regional Data and Plans	Lower Hawkesbury-Nepean River nutrient management strategy.	DECCW	2010	Regional Plan	Estuary-Scale	✓	✓	✓	✓	✓	✓	✓							✓	✓		✓	✓
Regional Data and Plans	The Marine Water Quality Objectives for NSW Ocean Waters - Sydney Metropolitan and Hawkesbury–Nepean	NSW DEC	2005	Technical Study	Estuary-Scale	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	✓
Regional Data and Plans	The NSW Water Quality and River Flow Objectives - Hawkesbury–Nepean	NSW DEC	2005	Technical Study	Estuary-Scale	✓	✓	✓	✓	✓													
Regional Data and Plans	MER: Assessing estuary ecosystem health: Sampling, data analysis and reporting protocols	OEH	2016	Technical Study	State	✓	✓	✓	✓	✓	✓												✓
Regional Data and Plans	Hawkesbury-Nepean River Sediment Dynamics Mapping Study. University of Sydney, Ocean Sciences Institute, Report no 53.	Harris et al	1994	Technical Study	Estuary-Scale	✓	✓																
Regional Data and Plans	NSW Estuary Tidal Inundation Exposure Assessment Report	OEH	2018	Technical Study	State	✓	✓	✓	✓	✓	✓					✓							✓
Regional Data and Plans	NSW Estuary Tidal Inundation Exposure Assessment Mapping	OEH	2018	Mapping	State	✓	✓	✓	✓	✓	✓					✓							✓
Regional Data and Plans	Coastal Erosion in New South Wales Statewide Exposure Assessment report	OEH	2018	Technical Study	State	✓	✓	✓	✓	✓	✓						✓						✓
Regional Data and Plans	Coastal Erosion in New South Wales Statewide Exposure Assessment Mapping	OEH	2018	Mapping	State	✓	✓	✓	✓	✓	✓						✓						✓
Regional Data and Plans	CM SEPP Mapping - Coastal Environment Area	OEH	2018	Mapping	State	✓	✓	✓	✓	✓	✓											✓	
Regional Data and Plans	CM SEPP Mapping - Coastal Use Area	OEH	2018	Mapping	State	✓	✓	✓	✓	✓	✓											✓	
Regional Data and Plans	CM SEPP Mapping - Coastal Wetlands	OEH	2018	Mapping	State	✓	✓	✓	✓	✓		✓										✓	
Regional Data and Plans	CM SEPP Mapping - Littoral Rainforests	OEH	2018	Mapping	State	✓	✓	✓	✓	✓		✓										✓	

APPENDIX C
CMP LINKAGES TO EXISTING PLANS

C-1 Regional Plans

This purpose of this Section is to provide an outline of the two regional planning documents that are relevant to the development of the CMP. The CMP will need to ensure alignment with the objectives and strategies outlined in those plans, and so an assessment of the strategic linkages is provided herein.

C-1-1 A Metropolis of Three Cities – the Greater Sydney Region Plan

A Metropolis of Three Cities – the Greater Sydney Region Plan was developed by the Greater Sydney Commission, and outlines the overarching vision for the Greater Sydney Region. The plans sets a 40-year vision (to 2056) and establishes a 20-year plan to manage growth and change for Greater Sydney in the context of social, economic and environmental matters (GSC, 2018). The plan outlines four (4) overarching goals of collaboration, liveability, productivity and sustainability, with ten (10) key directions identified to deliver those goals – and 40 objectives aligned with those directions. This framework is outlined in Figure C-1 and Figure C-2 below, which have been reproduced from the Plan. The CMP will need to support and establish alignment with these objectives – and the objectives most relevant to the CMP have been highlighted in yellow.

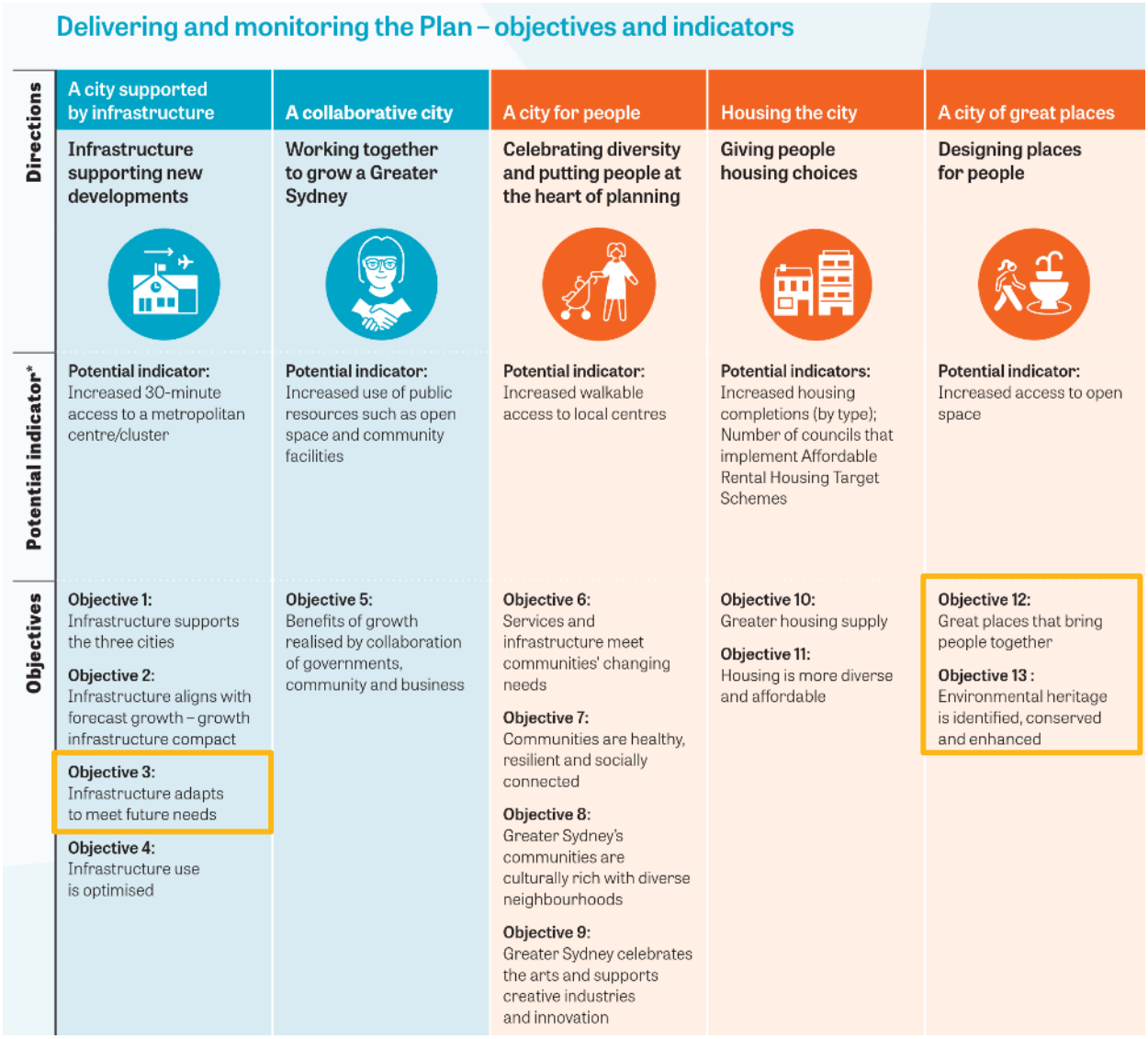

FIGURE C-1 DIRECTIONS AND OBJECTIVES OF THE GREATER SYDNEY REGION PLAN (SOURCE: GSC, 2018)

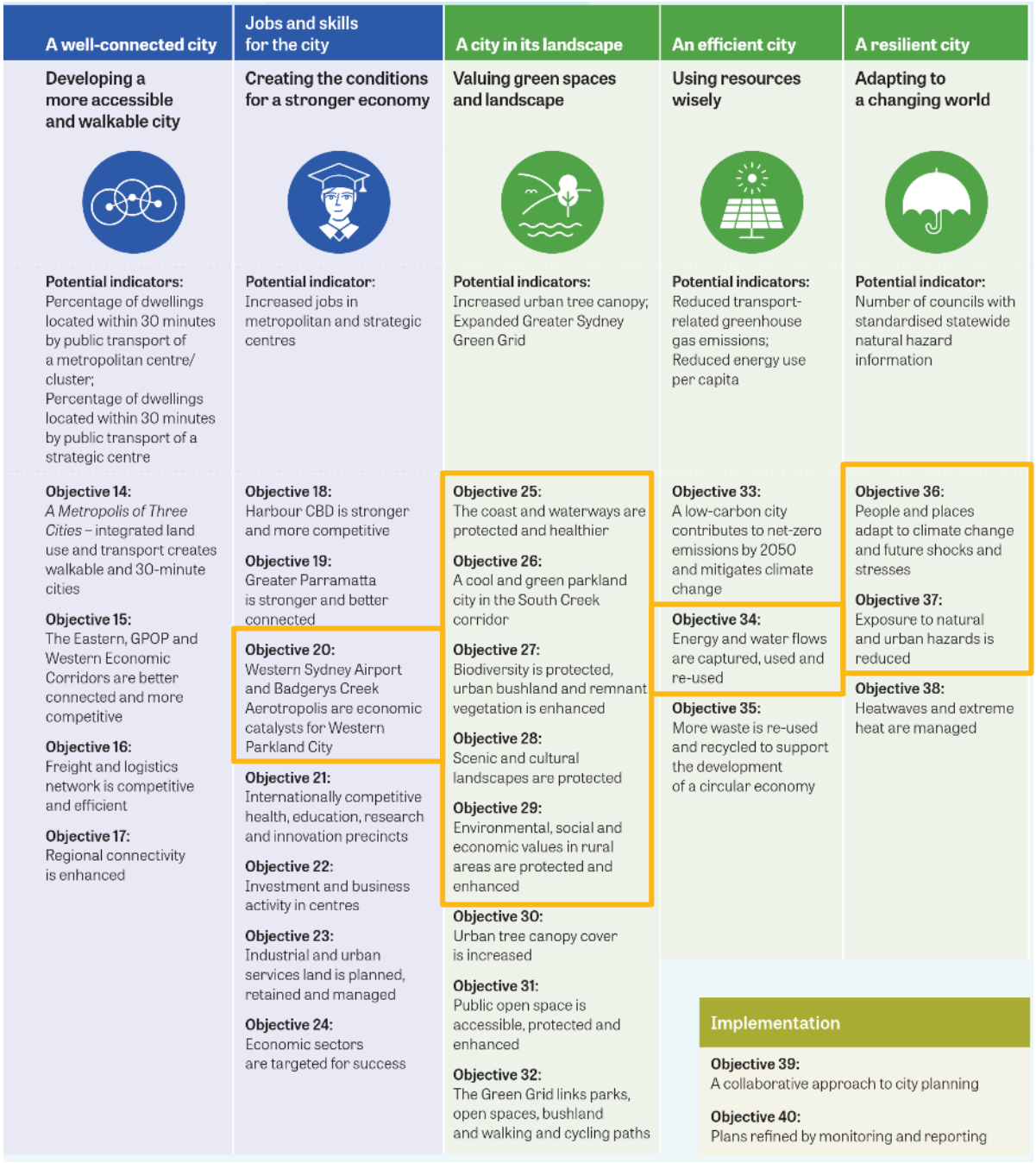

FIGURE C-2 DIRECTIONS AND OBJECTIVES OF THE GREATER SYDNEY REGION PLAN (SOURCE: GSC, 2018)

Sitting below the Regional Plan are five revised draft District Plans, which provide the framework to implement the Regional Plan. Greater Sydney's three cities reach across five districts: Western City District, Central City District, Eastern City District, North District and South District.

As part of the overarching Regional Strategy, plans gave been developed for each of these five districts that outlines a series of planning priorities. The three districts that encompass the Hawkesbury River Estuary, and its contributing catchment are the Western, Central and Northern Districts. The relevant planning priorities identified from each district plan that will require linkages to the strategic direction of the CMP are provided in Table C-1 below. This table demonstrates the consistency of the strategic planning priorities across each of the district plans.

TABLE C-1 PLANNING PRIORITIES FROM DISTRICT PLANS

Western City District	Central City District	North District
▪ W1 Planning for a city supported by infrastructure ▪ W2 Working through collaboration ▪ W12 Protecting and improving the health and enjoyment of the District's waterways ▪ W13 Creating a Parkland City urban structure and identity, with South Creek as a defining spatial element ▪ W14 Protecting and enhancing bushland and biodiversity ▪ W15 Increasing urban tree canopy cover and delivering Green Grid connections ▪ W16 Protecting and enhancing scenic and cultural landscapes ▪ W17 Better managing rural areas ▪ W18 Delivering high quality open space ▪ W20 Adapting to the impacts of urban and natural hazards and climate change	▪ C1 Planning for a city supported by infrastructure ▪ C1 Working through collaboration ▪ C13 Protecting and improving the health and enjoyment of the District's waterways ▪ C14 Creating a Parkland City urban structure and identity, with South Creek as a defining spatial element ▪ C15 Protecting and enhancing bushland, biodiversity and scenic and cultural landscapes ▪ C16 Increasing urban tree canopy cover and delivering Green Grid connections ▪ C17 Delivering high quality open space ▪ C18 Better managing rural areas ▪ C20 Adapting to the impacts of urban and natural hazards and climate change	▪ N1 Planning for a city supported by infrastructure ▪ N2 Working through collaboration ▪ N15 Protecting and improving the health and enjoyment of Sydney Harbour and the District's waterways ▪ N16 Protecting and enhancing bushland and biodiversity ▪ N17 Protecting and enhancing scenic and cultural landscapes ▪ N18 Better managing rural areas ▪ N19 Increasing urban tree canopy cover and delivering Green Grid connections ▪ N20 Delivering high quality open space ▪ N22 Adapting to the impacts of urban and natural hazards and climate change

C-1-2 Central Coast Regional Plan 2036

The Central Coast Regional Plan 2036 sets regional planning priorities for the Central Coast and provides guidance and direction for regional and local planning decisions over a 20-year period to 2036 (DoP, 2017). The plan outlines four (4) overarching goals of: A prosperous Central Coast with more jobs close to home, Protect the natural environment and manage the use of agricultural and resource lands, Well-connected communities and attractive lifestyles and A variety of housing choice to suit needs and lifestyles. The plan outlines 23 strategic directions intended to deliver those goals. Ad for the great Sydney Plan, the CMP will also need to support and establish alignment with these goal – the most relevant of which include those listed in Table B-3.

TABLE C-2 ALIGNED STRETAGIC DIRECTIONS FROM THE CENTRAL COAST REGIONAL PLAN 2036

Directions form the Plan
■ **Direction 8: Recognise the cultural landscape of the Central Coast** ▪ 8.1 Protect the Central Coast's scenic amenity by planning for development that respects the distinct qualities of different places. ▪ 8.2 Identify and protect heritage values to minimise the impact of urban growth and development, and to recognise its contribution to the character and landscape of the region.

Directions form the Plan
▪ 8.3 Complete cultural landscape mapping and implement the findings through appropriate local planning controls.
■ **Direction 9: Protect and enhance productive agricultural land** ▪ 9.2 Manage Biophysical Strategic Agricultural Land and other important agricultural land as locations for agricultural activities and complementary uses. ▪ 9.4 Protect the region's wellbeing and prosperity through increased biosecurity measures.
■ **Direction 10: Secure the productivity and capacity of resource lands** ▪ 10.1 Plan for the ongoing productive use of lands with regionally significant construction material resources in locations with established infrastructure and resource accessibility. ▪ 10.2 Ensure that longer term extractive resources are not sterilised and minimise impacts on communities and the environment.
■ **Direction 11: Sustain and balance productive landscapes west of the M1** ▪ 11.1 Identify and protect intensive agriculture clusters in local plans to avoid land use conflicts, particularly with residential and rural–residential expansion. ▪ 11.2 Encourage niche commercial, tourist and recreation activities that complement and promote a stronger agricultural sector, as well as build capacity to adapt to changing circumstances.
■ **Direction 12: Protect and manage environmental values** ▪ 12.1 Identify terrestrial and aquatic biodiversity values and protect areas of high environmental value to sustain the lifestyle, economic success and environmental health of the region. ▪ 12.2 Identify and strengthen biodiversity corridors as places for priority biodiversity offsets. ▪ 12.4 Strengthen the Coastal Open Space System by expanding its links and extending new corridors to balance growth in the north of the region and protect the network of natural areas across the region. ▪ 12.5 Sensitively manage natural areas on the fringe of the urban areas and in the west of the region to mitigate land use incompatibility issues and provide important quality of life and tourism benefits for the region.
■ **Direction 13: Sustain water quality and security** ▪ 13.1 Protect water catchments to sustain high quality and dependable water supplies across the region. ▪ 13.2 Effectively manage surface and groundwater use in agricultural areas to support ecosystem function, food production and cater for the increasing demands of urban communities and industry. ▪ 13.3 Incorporate water sensitive design into development that is likely to have an adverse impact on coastal water catchments, water quality and flows. ▪ 13.4 Plan for the security of the region's water supply. ▪ 13.5 Implement catchment-based plans for the ongoing sustainable management and health of estuaries in the region. ▪ 13.6 Apply neutral or beneficial water quality objectives to land use planning in surface and groundwater drinking catchments to minimise the effects of development on waterways including watercourses, wetlands, groundwater dependent ecosystems, riparian lands, estuaries, lakes, beaches and marine waters. ▪ 13.7 Plan new development to reduce the risk of introduction or spread of aquatic pests and diseases on fisheries and aquaculture industry practices.
■ **Direction 14: Protect the coast and manage natural hazards and climate change**

Directions form the Plan
▪ 14.1 Manage the risks of climate change and improve the region's resilience to hazards such as flooding, coastal erosion, bushfire, mine subsidence and land contamination. ▪ 14.2 Review and update floodplain risk and coastal management programs to manage flood risk and protect the coast, particularly where urban growth is being investigated. ▪ 14.3 Incorporate new knowledge on regional climate projections and related cumulative impacts in local plans for new urban development.
■ **Direction 17: Align land use and infrastructure planning** ▪ 17.1 Align land use and infrastructure planning to maximise the use and capacity of existing infrastructure, and the efficiency of new infrastructure.
■ **Direction 18: Create places that are inclusive, well-designed and offer attractive lifestyles** ▪ 18.3 Enhance the amenity and attractiveness of existing places.

C-2 Community Strategic Plans

There are six (6) local government areas that border the tidal waterways of the study area, and each of these Councils has prepared a Community Strategic Plan in order to set forth the overarching, vision for the LGA, that translates the community's key priorities and aspirations into long-term strategic goals. The CMP will need to support strategies and objectives outlined in each of the Pattern Councils Community Strategic Plan. In order to do this, this Scoping Study has identified the strategic linkages between those plans and the objectives of the CMP. These linkages are provided in Table C-3 below.

TABLE C-3 LINKAGES BETWEEN THE CMP AND COMMUNITY STRATEGIC PLANS

Community Strategic Plan	Strategies with linkages to the Hawkesbury-Nepean River System CMP
Central Coast One Central Coast: Central Coast, Community Strategic Plan 2018-2028	This Community Strategic Plan provides 17 overarching goals, each with 4 unique objectives. The objectives relevant to the CMP include: ▪ A1 Work within our communities to connect people, build capacity and create local solutions and initiatives ▪ A2 Celebrate and continue to create opportunities for inclusion where all people feel welcome and participate in community life ▪ A4 Enhance community safety within neighbourhoods, public spaces and places ▪ B4 Activate spaces and places to complement activity around town centres, foreshores, lakes and green spaces for families, community and visitors ▪ C1 Target economic development in growth areas and major centres and provide incentives to attract businesses to the Central Coast ▪ C2 Revitalise Gosford City Centre, Gosford Waterfront and town centres as key destinations and attractors for businesses, local residents, visitors and tourists ▪ C3 Facilitate economic development to increase local employment opportunities and provide a range of jobs for all residents ▪ C4 Promote and grow tourism that celebrates the natural and cultural assets of the Central Coast in a way that is accessible, sustainable and eco-friendly ▪ E1 Educate the community on the value and importance of natural areas and biodiversity and encourage community involvement in caring for our natural environment ▪ E2 Improve water quality for beaches, lakes and waterways including minimising pollutants and preventing litter entering our waterways ▪ E3 Reduce littering, minimise waste to landfill and educate to strengthen positive environmental behaviours ▪ E4 Incorporate renewable energy and energy efficiency in future design and planning and ensure responsible use of water and other resources

Community Strategic Plan	Strategies with linkages to the Hawkesbury-Nepean River System CMP
	▪ F1 Protect our rich environmental heritage by conserving beaches, waterways, bushland, wildlife corridors and inland areas and the diversity of local native species ▪ F2 Promote greening and ensure the wellbeing of communities through the protection of local bushland, urban trees, tree canopies and expansion of the Coastal Open Space System (COSS) ▪ F3 Improve enforcement for all types of environmental non-compliance including littering and illegal dumping and encourage excellence in industry practices to protect and enhance environmental health ▪ F4 Address climate change and its impacts through collaborative strategic planning and responsible land management and consider targets and actions ▪ G1 Build strong relationships and ensure our partners and community share the responsibilities and benefits of putting plans into practice ▪ G2 Communicate openly and honestly with the community to build a relationship based on transparency, understanding, trust and respect ▪ G3 Engage with the community in meaningful dialogue and demonstrate how community participation is being used to inform decisions ▪ I1 Preserve local character and protect our drinking water catchments, heritage and rural areas by concentrating ▪ development along transport corridors and town centres east of the M1 ▪ I2 Ensure all new developments are well planned with good access to public transport, green space and community facilities and support active transport ▪ I3 Ensure land use planning and development is sustainable and environmentally sound and considers the importance of local habitat, green corridors, energy efficiency and stormwater management ▪ K3 Provide signage, public facilities, amenities and playgrounds to encourage usage and enjoyment of public areas ▪ K4 Repair and maintain wharves, jetties, boat ramps and ocean baths to increase ease of access to and enjoyment of natural waterways and foreshores
Northern Beaches Shape 2028: Northern Beaches Community Strategic Plan 2018 - 2028	This Community Strategic Plan sets forth over 71 strategies that are compartmentalised into 22 distinct goals. The strategies relevant to the CMP include: ▪ 1a: Protect and restore local biodiversity and bushland ▪ 1b: Protect and improve ecological conditions in catchments, creeks and lagoons ▪ 1c: Protect and manage the condition and safe access to the coast, lagoons, Middle Harbour, and Pittwater ▪ 1d: Provide sustainable access to the natural environment, while recognising and protecting its cultural and heritage value ▪ 2a: Minimise the risk to life and property from storm events, floods, erosion, landslides, bushfires and impacts of climate change ▪ 2b: Increase the resilience of the environment to the effects of natural hazards and climate change

Community Strategic Plan	Strategies with linkages to the Hawkesbury-Nepean River System CMP
	▪ 2c: Maintain productive partnerships with government agencies and the community to effectively manage and respond to natural hazards ▪ 3a: Encourage the community to protect the environment and minimise pollution ▪ 3b: Invite community participation in restoring the natural environment through volunteering programs and education ▪ 4b: Enhance financial and strategic capacity to deliver on environmental outcomes ▪ 5a: Ensure integrated land use planning balances the environmental, social and economic needs of present and future generations ▪ 5b: Create green and resilient urban environments by improving tree cover, native vegetation, landscaping, and water management systems ▪ 5c: Promote the benefits and savings of ecologically sustainable development ▪ 5d: Continually improve environmental standards and compliance in new and existing developments ▪ 6b: Provide incentives and programs to encourage our community to enhance, preserve and protect our natural ecosystems ▪ 7a: Effectively plan for future growth by balancing regional priorities with local values ▪ 9a: Provide well-maintained and safe spaces that equitably support active and passive recreation ▪ 12c: Recognise and honour Aboriginal culture and heritage ▪ 15d: Enhance and extend opportunities for sustainable tourist economy throughout the area ▪ 19a: Demonstrate a high standard of transparency and accountability through community involvement and strong, timely reporting practices ▪ 19b: Establish a strong corporate governance framework to ensure decisions and transactions are ethical, efficient, and fair ▪ 19c: Ensure the long-term financial sustainability of Council through strategic management of assets ▪ 21a: Establish a fair and representative engagement structure that enables a diverse community to engage in local neighbourhood matters ▪ 22b: Enable community members to participate in decision-making by providing a broad range of engagement opportunities ▪ 22c: Undertake innovative and adaptive community engagement ▪ 22d: Improve community understanding of how decisions are made for the local area
Ku-ring-gai Community Strategic Plan - Our Ku-ring-gai 2038	The plan includes six themes that group issues and long-term objectives together. The objectives relevant to the CMP include: ▪ C7.1 An aware community able to prepare and respond to the risk to life and property from emergency events. ▪ N1.1 A community empowered with knowledge, learning and that benefits the environment. ▪ N2.1 Our bushland is rich with native flora and fauna. ▪ N3.1 Our natural waterways and riparian areas are enhanced and protected. ▪ N4.1 A community addressing and responding to the impacts of climate change and extreme weather events.

Community Strategic Plan	Strategies with linkages to the Hawkesbury-Nepean River System CMP
	▪ P1.1 Ku-ring-gai's unique visual character and identity is maintained. ▪ P5.1 Ku-ring-gai's heritage is protected, promoted and responsibly managed. ▪ E3.1 Ku-ring-gai has a range of activities and experiences that attract visitors. ▪ L1.1 A shared long-term vision for Ku-ring-gai underpins strategic collaboration, policy development and community engagement. ▪ L4.1 The community is informed and engaged in decision-making processes for community outcomes.
Hornsby Your Vision | Your Future 2028: Community Strategic Plan 2018 - 2028	The plan outlines a number of community outcomes, which are group in the four key themes. The relevant outcomes include: ▪ 1.1 Infrastructure meets the needs of the population ▪ 1.2 People have good opportunities to participate in community life ▪ 2.1 The local surroundings are protected and enhanced ▪ 2.2 People in Hornsby Shire support recycling and sustainability initiatives ▪ 2.3 The Shire is resilient and able to respond to climate change events and stresses ▪ 3.1 The prosperity of the Shire increases ▪ 4.1 The community is encouraged to participate in Council's decision making ▪ 4.2 Information about Council and its decisions is clear and accessible ▪ 4.3 Council plans well to secure the community's long-term future
The Hills The Hills Future 2017-2021 Community Strategic Plan	The document outlines 10 overarching community outcomes, with 21 specific strategies to achieve those outcomes. The relevant strategies include: ▪ 1.2 Through strong partnerships provide and support safety activities in relation to bush fire management and other emergency services to foster a safe community. ▪ 1.4 Recognise and value our community's local heritage and culture. ▪ 2.3 Supporting visitor economy in The Sydney Hills for planned growth. ▪ 3.1 Facilitating strong two-way relationships and partnerships with the community, involve them in local planning and decision making and actively advocate community issues to other levels of government. ▪ 3.3 Ensure Council is accountable to the community and meets legislative requirements and support Council's elected representatives for their role in the community. ▪ 5.1 The Shire's natural and built environment is well managed through strategic land use and urban planning that reflects our values and aspirations. ▪ 7.1 Provide and maintain sustainable infrastructure and assets that enhance the public domain, improve the amenity and achieve better outcomes for the community. ▪ 8.1 Provide new and refurbished infrastructure in a timely manner that meets the needs of our growing Shire.

Community Strategic Plan	Strategies with linkages to the Hawkesbury-Nepean River System CMP
	▪ 9.1 Effective regulatory strategies, local laws, and compliance programs manage public health and the impact of new and existing development on the community. ▪ 9.2 Demonstrate leadership in sustainable environmental performance and manage environmental risks and impacts responsibly and provide education and regulatory actions. ▪ 9.3 Manage new and existing development with a robust framework of policies, plans and processes that is in accordance with community needs and expectations.
Hawkesbury City Hawkesbury Community Strategic Plan 2017-2036	The plan outlines 5 Key Directions, and a total of 70 strategies designed to align Council with those directions. The relevant strategies for the CMP include: ▪ 1.2.1 Provide open and clear lines of communication with the community that use the most current forms of digital technology. ▪ 1.3.1 In all of Council's strategies, plans and decision making there will be a strong focus on financial sustainability. ▪ 1.3.2 Meet the needs of the community now and into the future by managing Council's assets with a long-term focus. ▪ 1.3.3 Decisions relating to determining priorities will be made in the long-term interests of the community ▪ 1.4.1 Foster positive relationships with all tiers of government and peak bodies ensure a thorough understanding of the challenges and local requirements of the Hawkesbury. ▪ 1.5.1 Undertake Council initiatives within a clear and fair framework of strategic planning, policies, procedures and service standards as required under all regulatory frameworks. ▪ 1.5.2 Best practice, sustainability principles, accountability and good governance are incorporated in all activities undertaken by Council. ▪ 2.1.1 Meet the needs of our community through effective flood, fire and other natural disaster management plans that promote the protection of life, property and infrastructure. ▪ 2.3.1 Encourage and facilitate community partnerships. ▪ 2.3.4 Develop opportunities for active involvement of residents in the management of parks and public spaces in the Hawkesbury. ▪ 2.5.3 Recognise, conserve and promote the area's history and heritage for current and future generations. ▪ 3.1.1 Encourage effective management and protection of our rivers, waterways, riparian land, surface and ground waters, and natural eco-systems through action and regional partnerships. ▪ 3.1.2 Act to protect and improve the natural environment, including working with key agency partners. ▪ 3.1.3 Minimise our community's impacts on habitat and biodiversity, and protect areas of conservation value. ▪ 3.1.4 Use a range of compliance measures to protect the natural environment. ▪ 3.2.1 Our community is informed and acts to reduce our ecological footprint. ▪ 3.3.2 Undertake community education on best practice environmental sustainability and climate change issues.

Community Strategic Plan	Strategies with linkages to the Hawkesbury-Nepean River System CMP
	▪ 3.4.2 Development is functional, attractive and sympathetic with the environment, and avoids unnecessary use of energy, water or other resources. ▪ 4.2.1 Our community's current and future utility infrastructure needs (water, sewer, waste, stormwater, gas, electricity and telecommunications) are identified and delivered. ▪ 4.2.2 New development and infrastructure provision is aligned and meets community needs. ▪ 4.3.1 Provide a variety of quality passive recreation spaces including river foreshores, parks, bushland reserves and civic spaces to enhance our community's health and lifestyle. ▪ 5.1.1Council's Planning is integrated and long term. ▪ 5.1.2 Council's decision making on all matters is transparent, accessible and accountable. ▪ 5.2.1Our planning and actions will ensure that Aboriginal and Non-Aboriginal heritage are integral to our City. ▪ 5.2.2 Encourage and implement progressive urban design, sensitive to environment and heritage issues. ▪ 5.3.1Growth and change in the Hawkesbury will be identified, planned for and valued by the community. ▪ 5.3.3 Plan for a balance of agriculture, natural environment and housing that delivers viable rural production and maintains rural character. ▪ 5.4.1Celebrate and use our rivers for a range of recreation, leisure, tourism and event activities. ▪ 5.4.2 Develop active partnerships and implement programs designed to improve the health of our rivers and river banks. ▪ 5.4.3 Encourage agriculture production, vegetation conservation, tourism, recreation and leisure uses within our floodplains. ▪ 5.8.5 Plan for the continuance and growth of agricultural industry uses within Hawkesbury.

C-3 Greater Sydney Local Land Services Local Strategic Plan 2016-2021

TABLE C-3 RELEVANT STRATEGIES FROM THE GSLLS STRATEGIC PLAN 2016-2021

Strategy	Directions form the Plan
1	▪ Provide data, information and knowledge that supports and enable land mangers, customers and government to improve decision making
4	▪ Collaborate with investors, stakeholders and external organisations to delivery products and services to customers
5	▪ Ensure local people participate in decision making
6	▪ Connect research and development with advisory services to address priority data, information and knowledge gaps and barriers to improve practice
7	▪ Deliver services that support Aboriginal people to care for County and share traditional management knowledge
9	▪ Manage Crown Land vested in Local Land Services for environmental and economic outcomes

APPENDIX D
STAGE 1 STAKEHOLDER ENAGAGEMENT SUMMARIES

COMMITTEE MEETING #1: WORKSHOP SUMMARY

Subject Hawkesbury River System Coastal Management Program Scoping Study – Stakeholder Engagement Workshop

Date Monday 9th September – from 09:00 to 14:30

Location Hornsby Shire Council Office
296 Peats Ferry Road Hornsby
NSW, 2077 Australia

1 INTRODUCTION

Many thanks to all of the stakeholders who attended the Stakeholder Engagement Workshop for the Hawkesbury River System CMP Scoping Study. The workshop included robust & informative discussions from a diverse range of knowledge bases and viewpoints. The discussions held during the workshop and the information obtained therein will be used to drive development of the study, and set the stage for the remainder of the CMP process.

In total, 20 stakeholders attended the day, from a number of different organisations. Neil Dufty of Molino Stewart and Chris Beadle of Water Technology were also in attendance and facilitated the workshop. The attendees list is provided below in Table 1-1.

Table 1-1 Attendees List

Organisation	Name		Organisation	Name
Partner Councils			**State Government Agencies**	
Hornsby Shire Council	Ana Rubio		DPIE (Planning)	Maria Plytarias
Hornsby Shire Council	Tim McDonald		DPIE (Environment)	Peter Scanes
Northern Beaches Council	Bob Hunt		DPIE (Environment)	Peter Freewater
Northern Beaches Council	Jodie Crawford		DPIE (EES)	Neil Kelleher
The Hills	Lauren Vallejo		NPWS	Sophia Meehan
Ku ring gai Council	Sophia Findlay		Sydney Water	Jenny Rogers
Hawkesbury City Council	Michael Patterson		DPI Fisheries	Sarah Conacher
Central Coast Council	Warren Brown		DPI Fisheries	Karen Astles
Wider Catchment Councils			**Local Aboriginal Land Councils**	
Blacktown Council	Kristy Good		Darkinjung LALC	Christine Hammond
Penrith Council	Tim Gowing			
Wollondilly Shire Council	Bruce Devonport			

The following people could not attend and sent their apologies. These stakeholders will be provided a summary of the day, and will be liaised with regarding receipt and return of electronic consultation work sheets.

Table 1-2 Apologies List

Organisation	Name
Crown Lands	Paul Harper
Greater Sydney LLS	Rebecca Mooy
Sydney Water	Iain Fairbairn
TfNSW (RMS)	Dan Duemmer
Infrastructure NSW (Hawkesbury-Nepean FRM Directorate)	Stephen Yeo
Blue Mountains Council	Amy St Lawrence

The workshop itself was interactive and participatory, and the purpose was to:

- Communicate the strategic context and drivers of the CMP
- Confirm management roles and responsibilities across coastal zone
- Identify the values, threats and risks across the study area
- Discuss the potential benefits, challenges and barriers for preparing a river system-wide CMP.

A succinct overview is provided herein.

2 WORKSHEETS AND WORKBOOKS

The three interactive sessions across the day involved the stakeholders completing a series of worksheets that were collected and complied by the project team at the end of the day.

It is acknowledged that many of the attendees will need to liaise with other individuals within their organisation in order to complete their worksheets, particularly for the first session that intended to summarise the responsibilities of the various stakeholder agencies across the river system. Therefore, a two-week period has been allowed for attendees to complete the worksheets and return to the project team electronically. To this end, each attendee was also provided a bound "take-home" workbook that provided additional worksheets for completion - and some relevant background information to assist the process. A soft copy of this workbook will also be provided (electronically) to those could not attend.

The required return date for submission of the worksheets is **Wednesday 25th September.** Worksheets can be returned electronically via email to chris.beadle@watertech.com.au.

3 SESSION 1: EXISTING COASTAL MANAGEMENT ARRANGEMENTS

A review was undertaken of the existing coastal management arrangements across the river system. For this task, stakeholders provided an overview of the various management responsibilities of their organisation. For each responsibility, information was provided regarding management objectives, barriers to implementation, and linkages with other organisations.

For this task it was acknowledged that attendees will need to liaise with other individuals within their organisation in order to complete their worksheets – as discussed above.

4 SESSION 2: VALUES, THREATS AND RISKS

In the first instance, stakeholders were provided a list of values and then a discussion was undertaken in order to expand upon that list in order to identify the full suite of environmental, social and economic values of the study area. During these discussions it was noted the many of the provided "values" were more generally considered to be *indicators* of higher level values, rather than being values themselves. Subsequently, it was agreed that a greater alignment on the values of the river system was required with the with the *community environmental values and uses* outlined in the *NSW Water Quality and River Flow Objectives*. Furthermore, it was agreed that proposed task of assigning numeric importance scores to the relative values was both of little benefit and overly simplistic given the interdependencies and linkages between such values, and their spatial variability across the study area. Therefore, the task involved largely expanding of the provided list of values, establishing linkages to the Water Quality Objectives and providing site specific examples where beneficial.

This workshop also included a wider discussion regarding the suitability of direct community engagement during the Stage 1 Scoping Study process in order to assist with the assessment of community and social values & uses. It was suggested that this potential component of the project should be discussed further by the Project Steering Committee. Regardless, it was considered that a review of community and stakeholder engagement tasks undertaken as part of previous plans and studies should be undertaken in order to map previous assessments of community values for the area across the values and uses outlined in the Water Quality Objectives for NSW waterways.

The attendees then split into 4 separate groups (ranging in size from 3 to 8 people) and considered the suite of various threats to the aforementioned values along the study area. Each group considered a particular threat category, that was based on the threats identified in the Marine Estate Management Authority Threat and Risk Assessment (TARA). Attendees self-sorted into groups based on their individual area of expertise and interest. This task was intended to assist in the first pass risk assessment to be undertaken during the scoping study. The exercise involved considering the risk level associated with the various threats, any management plans currently in place to address these risks, and potential changes to the risk level anticipated over future planning horizons.

5 SESSION 3: CMP STUDY AREA AND GOVERNANCE STRUCTURE

The workshop included a SWOT analysis discussion of the River-Wide CMP structure. During this process, discussions were held regarding the potential opportunities and barriers to the delivery and implementation of a River-Wide CMP. Comparisons were drawn to similar estuary wide CMP's undertaken for the Richmond River estuary and Sydney Harbour Estuary. There was general support by the partner Councils and state agency representatives for a River-Wide CMP, however there are details around project governance and roles/responsibility need to be considered and worked through. Key messages will also need to be developed in order to for Councils to internally to promote the benefits of a coordinated system-wide approach to the CMP.

Potential options for a governance structure of the proposed CMP were also considered. Examples included the Georges River Keeper and the Sydney Coastal Councils Group (a TOR may be available for the group), and the implementation of a specific independent chair role to address issues and drive the CMP, such as the role that Bruce Thom undertakes for the Sydney Harbour CMP. The pros and cons of various structures were discussed at a high level, and it was acknowledged that the Scoping Study should consider various options and provide a reasoned justification for the recommended structure.

The possibility of implementing different structures for different stages of the project was also discussed, and potential barriers identified.

6 ACTIONS

The following actions have arisen from the workshop.

Table 6-1 Actions

Actions	Champion	Timeframe
The project team is to provide electronic copies of the workbooks to attendees, to assist with completion of the worksheets.	Project Team	11/9/2019
Attendees are particularly asked to consider ***Worksheet 1: management roles and responsibilities*** for additional work and return of updated sheets. Additional responses for other sessions & worksheets can be provided if desired.	All Stakeholders (as necessary)	25/9/2019
The project team is to liaise with those who could not attend and provide electronic copies of the workbooks to attendees, to assist with completion of the worksheets.	Project Team	11/9/2019
Project Steering Committee to revisit and consider suitability of direct community engagement during the Stage 1 Scoping Study process	Project Steering Committee & Project Team	27/9/2019
Project Team to provide reminder and agenda for the next Steering Committee Meeting.	Project Team	27/9/2019
The project team is to continue to provide progress updates to both the Project Steering Committee and the wider Project Partners (such as the higher catchment Councils).	Project Team	Ongoing

7 CONCLUDING REMARKS

If you have any comments or would like to discuss anything further, please contact me at any time.

Looking forward to seeing you all there on the day.

Kind Regards,

Christopher Beadle
Water Technology

COMMITTEE MEETING #2: WORKSHOP RUN SHEET

Subject Hawkesbury River System Coastal Management Program Scoping Study – Stakeholder Engagement Strategy Workshop

Date Monday 4th November from 09:30 to 12:30

Location Hornsby Shire Council Office
296 Peats Ferry Road Hornsby
NSW, 2077 Australia

1 THE WORKSHOP

Many thanks to all of the stakeholders who attended the latest Stakeholder Engagement Workshop for the Hawkesbury River System Coastal Management Program (CMP) Scoping Study. The discussions held during the workshop were used to assist in the development of the CMP's Stakeholder and Community Engagement Plan (the Plan).

The workshop included a facilitated discussion regarding the content and methods to be included in the Plan. The workshop was around 3 hours in length, and was attended by at least two members of each of the Partner Councils: comprising one project officer, and one community engagement specialist. Neil Dufty of Molino Stewart and Chris Beadle of Water Technology were also in attendance and facilitated the workshop. The attendees list is provided below in Table 1-1.

Table 1-1 Attendees List

Organisation	Project Officer(s)	Comms Officers
Hornsby Shire Council	Ana Rubio Tim McDonald	Tracy Bass
Northern Beaches Council	Bob Hunt	Lindy Riese
The Hills	Lauren Vallejo	Michael Starr
Ku ring gai Council	Sophia Findlay	Emma Treadgold
Hawkesbury City Council	Michael Patterson	Melissa Barry
Central Coast Council	Warren Brown Vanessa McCann	Alison Chisolm
DPIE	Peter Freewater	

The workshop included an initial briefing session to provide background and context (particularly for comms officers who did not necessarily have thorough background into the CMP process), and was then followed by a series of "world café sessions" to discuss content and ideas. The purpose of the workshop was to:

- Identify possible content and messages for different stakeholder audiences;
- Identify possible engagement methods for different stakeholder audiences; and
- Discuss logistics that should be considered in the CMP Stakeholder and Community Engagement Plan.

The run sheet for the workshop is given in Table 1-2 below.

Table 1-2 Stakeholder Engagement Workshop Run Sheet

Time	Component

09:30 – 09:40	**Introduction**
	■ Welcome and introductions
	■ Outline of the day and objectives of the workshop
	■ What is a CMP?
	  ■ Stages of the CMP
	  ■ River system approach

09:40 – 10:00	**Briefing: Background to CMP and Engagement Requirements** ■ The purpose of the CMP Stakeholder and Community Engagement Strategy ■ The Coastal Management Manual and the Community Engagement Toolkit ■ The IAP2 Spectrum ■ Council engagement strategies ■ Previous CZMP engagement undertakings ■ Community Values
10:00 – 10:10	■ Questions of Clarification / Comments
10:10 – 11:00	**World Café #1: Local Content** ■ Stakeholder Identification ■ Identification of appropriate context and content for Stages 2 to 5
11:00 – 11.15	**Morning Tea Beak**
11:15 – 12:00	**World Café #2: Engagement Methods** ■ Identification of appropriate engagement methods for Stages 2 to 5
12:00 – 12:20	**World Café #3: Logistics** ■ Identification of logistical issues, e.g. responsibilities, timing, and locations for engagement
12:20 – 12:30	**Debrief** ■ Agreement upon preferred engagement plan template ■ Where to from here?

It was noted during the introductory briefing, that there exists a great deal of guidance for the development CMP stakeholder engagement plans in the *NSW Management Manual and toolkit*. Therefore, the purpose of the workshop was to engage and consult with the Partner Councils (and their communications officers) in order harness the local expertise and knowledge that would allow for the development of a bespoke and locally tailored engagement plan for the Hawkesbury River System CMP.

Furthermore, most of the Partner Councils have existing community and stakeholder engagement frameworks and templates in place - and it will be necessary for the Plan to compliment, and be consistent with, these existing frameworks and strategies.

2 WORKSHOP SUMMARY

2.1 World Café #1: Contents and Messaging

The attendees were divided into 3 groups of approximately 4-6 persons. Project Officers and Comms officers from each Council were paired together, and worked a corresponding pair from another Council (Figure 2-1). This grouping method was intended to encourage coordination both within Council (between project and comms officers) but also across the various Councils. Each group discussed the various contents and key messaging themes that should be utilised in the Community and Stakeholder Engagement Plan for the CMP.

Figure 2-1 The World Café Sessions

For each Stage of the CMP, the objectives from the *NSW Coastal Management Manual Engagement Guidelines* were mapped out, and then discussions were held in order to identify the key messaging themes required to achieve those objectives.

The messaging and content discussion involved considerations of the different audiences / stakeholder groups such as the local community, Councils(s), and other stakeholders such as NSW Stage Government Agencies. The process allowed for the identification of the overarching messaging themes of the CMP to be developed, whilst maintaining the granularity / specificity of the requirements of each CMP Stage and stakeholder group.

2.2 World Café #2: Methods

The purpose of the second World Café session was to identify the possible engagement methods that could be used for different stakeholder audiences across the various stages of the CMP. For this session each Council was paired with a different Council to the previous session – in order to encourage intra-council collaboration.

Discussions were used to develop a suite of engagement methods that were tailored to the different stakeholder audiences. The development of these methods needed to consider a number of factors including the demographics of each LGA, the effectiveness of historical engagement methods, and the contents and messaging themes for each CMP stage discussed during the previous workshops.

2.3 World Café #3: Logistics

For the final session, the Council groups were again shuffled. This World Café Session involved discussion of the logistics associated with the potential engagement methods identified in the previous session. For

each engagement method, Councils provided LGA specific information regarding the logistics of implementation - including opportunities and constraints around timing (and the potential to link with local community events and festivals), possible venues, and organisational responsibilities.

3 THE NEXT STEPS

Table 3-1 Actions Emanating from Workshop

Action	Responsibility	Completion Date
The Partner Councils have a two-week period to provide additional responses for the workshop sessions. The worksheets have been provided as an attachment to this summary document. All responses should be supplied in the worksheets attached herein – and emailed to chris.beadle@watertech.com.au by Monday 18 November 2019.	Partner Councils	Mon 18/11
The Project Team will develop an engagement template and send through to the partner Councils for review.	Project Team (WT and MS)	Mon 18/11
The Partner Councils will have a two-week period to review the engagement template and provide comments and feedback to the Project Team	Partner Councils	Mon 2/12
The Draft Stakeholder Engagement Plan will be provided as an appendix to the Draft Scoping Study Report. Comments on the Plan should be complied with overall scoping study report comments.	Project Team (WT and MS)	Fri 20/12

Once again, many thanks to all of the stakeholders who attended and provided input. If anyone has any comments regarding this summary or the actions outlined herein, please fell free to contact me at any time.

Kind Regards,

Christopher Beadle
Water Technology

WORLD CAFÉ #1: CONTENT

Stage	Engagement Outcomes	Stakeholder Group	Content & Messages
2	A shared understanding of risks and opportunities	▪ Community ▪ Council(s) ▪ Other Stakeholders	
	The range of actions that could address different risks		
	A shared understanding of the varied perspectives about coastal management		
	Stakeholders understand vulnerabilities, risk and opportunity studies, including technical aspects		
	Increased community trust of technical information based on their involvement and understanding of assumptions and limitations		
3	Strong working partnerships	▪ Community ▪ Council(s) ▪ Other Stakeholders	
	Managers within council aware of coastal hazards, threats, risks and vulnerabilities, opportunities and actions relevant to their responsibilities		
	Public authorities contribute to identification and evaluation of management options, are aware of responsibilities		
	Robust options, understood by all stakeholders in terms of risks, cost and benefits		
4	Community and stakeholder support for actions and priorities in the CMP	▪ Community ▪ Council(s) ▪ Other Stakeholders	
	Increased awareness about funding options		
5	Community understanding of how CMP will be implemented through the IP&R framework and land use planning system; and by other public authorities	▪ Community ▪ Council(s) ▪ Other Stakeholders	
	Community informed about progress on actions		
	Community is aware of the effectiveness of actions in terms of changes to coastal risk profile, coastal condition and community satisfaction		
	Continue partnership with community by creating opportunities for community involvement in implementing, monitoring, evaluating and reporting effectiveness of CMP		

WORLD CAFÉ #1: METHODS

Stage	Engagement Outcomes	Stakeholder Group	Content & Messages
2	A shared understanding of risks and opportunities	▪ Community ▪ Council(s) ▪ Other Stakeholders	
	The range of actions that could address different risks		
	A shared understanding of the varied perspectives about coastal management		
	Stakeholders understand vulnerabilities, risk and opportunity studies, including technical aspects		
	Increased community trust of technical information based on their involvement and understanding of assumptions and limitations		
3	Strong working partnerships	▪ Community ▪ Council(s) ▪ Other Stakeholders	
	Managers within council aware of coastal hazards, threats, risks and vulnerabilities, opportunities and actions relevant to their responsibilities		
	Public authorities contribute to identification and evaluation of management options, are aware of responsibilities		
	Robust options, understood by all stakeholders in terms of risks, cost and benefits		
4	Community and stakeholder support for actions and priorities in the CMP	▪ Community ▪ Council(s) ▪ Other Stakeholders	
	Increased awareness about funding options		
5	Community understanding of how CMP will be implemented through the IP&R framework and land use planning system; and by other public authorities	▪ Community ▪ Council(s) ▪ Other Stakeholders	
	Community informed about progress on actions		
	Community is aware of the effectiveness of actions in terms of changes to coastal risk profile, coastal condition and community satisfaction		
	Continue partnership with community by creating opportunities for community involvement in implementing, monitoring, evaluating and reporting effectiveness of CMP		

WORLD CAFÉ #3: LOGISTICS

Engagement methods	Timing Considerations	Venue	Responsibilities

APPENDIX E
MANAGEMENT PLAN - AUDIT OF IMPLEMENTATION

Lower Hawkesbury Estuary Management Plan								
ID	**Strateg**	**Rank**	**Strategy**	**Category**	**Lead Responsibility**	**Support Responsibility**	**Status**	**Comments**
1	1a	1	Conduct assessments to determine the carrying capacity of land areas (based on water, air, biodiversity and land capabilities) and limits for sustainable development within the entire catchment.	Research	HSC (Estuary Unit), GCC, HSC (Bushland and biodiversity)	HNCMA, DoP, NSW DPI	**Completed**	Land Capability project F2009/00865; Alluvium Priority Creek Study
2	1b	3	Collect information to inform amendments to planning controls based on the assessment of land capability, estuary carrying capacity (future population and development within the catchment) and ecological assessments.	Research	HSC (Estuary Unit), GCC	DoP, HSC(Town Planning)	**Implemented and Ongoing**	Astles, 2009 – geomorph- estuarine habitat
3	1c	51	State Government to reconsider regional strategies based on outcomes of sustainability and land capability assessments.	Planning	DoP	HSC (Town Planning Services) , GCC	**In progress / Incomplete**	Greater Sydney Plan and North District Plan released by not informed by Land Capability Study. Council now progressing with LSPS work to guide growth.
4	1d	5	Determine sustainable limits for recreational activities (types, numbers and locations) and the requirements for existing/new facilities and access to achieve sustainable limits on foreshores and waterways of the estuary (ie, suitable locations, unsustainable locations requiring removal, locations requiring restoration, new sustainable locations).	Research	HSC (Estuary Unit), GCC	NSW Maritime, DECC, DPI	**Implemented and Ongoing**	Crosslands/ Wisemans Ferry/Phd projects/ recreational Needs analysis report/economic evaluation of Lower Hawk (report on website)
5	1e	45	Review waterway access locations and requirements to consider all stakeholder needs with recommendations from the review informing appropriate Planning and Works Programs.	Research	HSC (Parks), GCC	HSC (Estuary Unit), HSC (Town Planning Services), HSC (Bushland and biodiversity) , GSC, stakeholders	**Implemented and Ongoing**	Boating program – Wisemans Ferry; OISAS commnts
6	1f	10	Develop and implement an Estuary Processes and Issues Checklist (EPIC) and integrate the checklist into councils planning controls. (The checklist is required to be completed and submitted with DA documentation. The checklist will require applicants and council planners to assess the likely impacts of DAs upon the natural processes, estuary values and sustainability of the Lower Hawkesbury Estuary).	Research	HSC (Estuary Unit), GCC	HSC (Town Planning Services), HSC (Bushland and biodiversity) ,	**Completed**	NR Referral layer in DA process; EPIC checklist developed but not fully implemented;
7	1g	4	Ensure planning instruments incorporate best practise: sediment, erosion and stormwater controls (eg construction controls plans and WSUD); use of water reduction devices and maximal permeable surfaces, landscaped area calculations: protection of native vegetation; sewage management (eg low risk OSSMs); restriction of landscaping and gardens to endemic species; energy efficient design and ESD.	Planning	HSC (Town Planning Services) , GCC	DoP, HSC (Estuary Unit)	**Implemented and Ongoing**	DCP controls, BASIX, DPI healthy Estuaries/healthy oysters; Env friendly seawalls; comments on CM SEPP
8	1i	29	Ensure suitable controls are contained within planning instruments for the design of foreshore development including recreational facilities to maintain the estuary shoreline in as natural state as possible and minimises potential for bank erosion.	Planning	HSC (Town Planning Services), GCC	DoP, HSC (Estuary Unit)	**Implemented and Ongoing**	Env friendly seawalls; DCP review
9	1j	33	Incorporate appropriate provision in planning instruments to require all Marinas to provide accessible pumpout facilities as a component of their licence to operate in the Lower Hawkesbury.	Planning	HSC (Town Planning Services), GCC	DECC, HSC (Estuary Unit)	**Unknown**	
10	1k	35	Incorporate provisions within planning controls to require all new dwellings or major alterations and additions to existing dwellings in the vicinity of priority oyster harvest areas to consider installation of pumpout sewage systems where feasible.	Planning	NSW DPI, NSW Food Authority, HSC (Estuary Unit)	DECC, HSC (Town Planning Services)	**Implemented and Ongoing**	NR referral layer in DA process; DPI healthy Estuaries/healthy; Oyster MoU
11	1l	57	Encourage conservation of native vegetation on private land	Education	HNCMA, HSC (Bushland and biodiversity) ,	GCC, DECC	**Implemented and Ongoing**	HSC weed officer on private land; grants implemented dealing with weeds, LEP Biodiversity layer
12	2a	22	Undertake an audit of planning compliance to review the effectiveness of development consent conditions to protect estuary assets and achieve sustainability. (eg an audit of the types of development being approved for consistency with sustainable growth limits and estuary asset protection goals).	Planning	HSC (Assessments), GCC	HSC(Estuary Unit)	**In progress / Incomplete**	
13	2b	30	Define and map minimum buffer widths for riparian/foreshore vegetation in relevant planning documents (LEPs, DCPs etc) to protect estuary assets and account for landward migration of habitat due to sea level rise.	Planning	DECC	HSC(Town Planning Services), HSC(Estuary Unit), GCC	**In progress / Incomplete**	New landuse zone for estuary EW; catchment health-riparian buffers
14	2c	103	In all Development Control Plans, information on the existing environmental context and desired future character is to be included in order to provide a more complete strategic approach.	Planning	HSC(Town Planning Services), GCC	HSC (Estuary Unit)	**Implemented and Ongoing**	
15	2d	14	During the review of plans of management for all parks and reserves (both national and council managed), ensure estuary assets are preserved (including habitat values for native animals, animals listed under the TSC Act 1995, prescribed burning and bushfire suppression undertaken according to park/reserve fire management plan, etc).	Research	DECC , HSC(Parks), HSC(Bushland) and Biodiversity), GCC	DPI, Maritime NSW	**Implemented and Ongoing**	Review of mgt plans for NSWP; hazard reduction burns; sandstone steps in Brooklyn
16	2e	2	Develop a strategy for sustainable recreation across the Lower Hawkesbury, which states the sustainability of locations, facilities and access based upon recreational survey and other data.	Research	HSC(Parks), HSC (Bushland and biodiversity) , GCC	HSC (Estuary Unit), DECC, Maritime NSW, DPI Fisheries	**Implemented and Ongoing**	Sustainable Water Based Recreational Facilities Plan

Lower Hawkesbury Estuary Management Plan								
ID	**Strateg**	**Rank**	**Strategy**	**Category**	**Lead Responsibility**	**Support Responsibility**	**Status**	**Comments**
17	2f	122	Prohibit reclamation activities in all planning instruments.	Planning	HSC (Town Planning Services) HSC(Estuary Unit), GCC	DoP, DECC	**Implemented and Ongoing**	How efficient they are? Not sure
18	2g	77	Liaise with the Metropolitan LALC and other indigenous groups to assess if the current level of management of aboriginal sites around the estuary is appropriate.	Planning	DECC	HSC (Parks), HSC(Estuary Unit), GCC, HNCMA	**In progress / Incomplete**	Record of some presentation, min communication
19	2h	138	Prepare management plans for commercial and recreational fishing (based upon the findings of commercial and recreational fishing surveys and research into fishing impacts) which outline fishing parameters to sustain fish stocks and aquatic habitats (including zones appropriate to various fishing amounts (bag limits) and practices, use of bycatch devices and non-target species avoidance techniques). The plan needs also to address potential issues with visiting commercial fishers.	Planning	DPI Fisheries	Councils, Maritime NSW	**Implemented and Ongoing**	Is Council able to prohibit this activity? Wouldn't it come down to NSW DPI – Fisheries response to issuing (or declining) application for Dredging/Reclamation Permit under FM Act?
20	2i	105	Ensure commercial fishers minimise the catch of non-target species, the incidental catch of non-utilised species, marine mammals, reptiles, seabirds and impacts on associated or dependent species using such measures as mesh or gear modifications, closed areas and bycatch reduction devices.	Compliance	Commercial Fishers	DPI Fisheries, DECC, Maritime NSW	**Completed**	Jelly bubblers channels in nets; good fishers will have skills to avoid by-catch
21	2j	102	Enforce compliance of recreational fishers with regulations on bag limits, minimum fish sizes etc	Compliance	DPI Fisheries	DECC, Maritime NSW	**Implemented and Ongoing**	Not sure how often or how efficient
22	2k	106	Educate all commercial fishers on methods to minimise the catch of non-target species, the incidental catch of non-utilised species, marine mammals, reptiles, seabirds and impacts on associated or dependent species. Such methods include mesh or gear modifications, closed areas and bycatch reduction devices.	Education	DPI Fisheries	DECC, Councils	**Completed**	
23	2l	141	Educate commercial fishers to ensure they understand the immediate action required to mitigate impacts on protected or endangered species from their trawling operations	Education	DPI Fisheries	DECC, Maritime NSW	**Implemented and Ongoing**	Not sure how efficient they are
24	2m	94	Identify significant seagrass beds on NSW Maritime boat charts and stickers and undertake education program to promote protection of seagrass	Education	Maritime NSW,	DPI, HSC (Estuary Unit)	**Completed**	Done – stickers and maps; buoys; app
25	2n	34	Riparian zones in priority agricultural areas fenced to prevent access of livestock to estuary, protect and encourage rehabilitation of riparian vegetation.	Capital work	HNCMA	DECC, HSC(Bushland and Biodiversity), GCC	**In progress / Incomplete**	We have cases in which this is still on-going,N.B. mapping exercise would be useful to enable targeted support/projects through partnerships
26	2o	59	Undertake comprehensive of mapping of the extent and condition of riparian habitats (including mangroves, saltmarsh and wetland species) in the Lower Hawkesbury and review periodically	Research	DPI Fisheries	HSC (Estuary Unit), GCC, DECC	**Implemented and Ongoing**	Astles report; mangrove investigation; OTR Wetland; Ecohealth; program
27	2p	90	Improve native vegetation condition through revegetation of priority areas (based on habitat mapping)	Capital work	HNCMA	DECC, HSC(Bushland and Biodiversity), GCC	**Implemented and Ongoing**	Estuarine sites assessment- project funded by GSLLS. Also work in upper catchment, As per 2q
28	2q	100	Expand bush regeneration programs and conservation programs for specific priority species	Capital work	HNCMA	DECC, HSC(Bushland and Biodiversity), GCC	**Implemented and Ongoing**	Floating Landcare; Bushcare
29	2r	101	Provide incentives to landholders to conserve significant habitats and native vegetation identified on private land (e.g. through property vegetation plans and voluntary conservation agreements)	Capital work	HNCMA	DECC, HSC(Bushland and Biodiversity), GCC	**Implemented and Ongoing**	CMA/LLS funds for private land – we need more
30	2s	80	Initiate a program for the removal of rubbish (including derelict boats) from riparian areas. The clean up program should focus on larger items such as derelict boats and dumped construction materials, with input and assistance from industry groups and volunteers.	Capital work	HNCMA, HSC (Estuary Unit)	Clean up Australia day Council, CMA, DPI Fisheries, GCC, DoL	**Implemented and Ongoing**	Clean4Shoree/ other Clean-ups
31	2t	146	Identify, protect, enhance and rehabilitate sites of Indigenous cultural significance, in collaboration with local indigenous groups (e.g. middens subject to erosion)	Capital work	DECC	HSC (Town Planning Services), GCC, NSW Maritime, HNCMA	**Implemented and Ongoing**	Ongoing as there are legislative controls and heritage requirements for all development (room for improvement!). The gap may be in collaboration from time to time.
32	2u	147	Identify, protect, enhance and rehabilitate sites of European heritage significance, in collaboration with local historical societies.	Capital work	DECC	HSC (Town Planning Services), GCC, NSW Maritime	**In progress / Incomplete**	Work on Bar Isl/ gentlemans halt; HMAS Parramatta
33	2v	6	Employ a River Keeper for the Lower Hawkesbury estuary, to assist in compliance, education and on-ground works (eg boat speeds and zones, seagrass protection, effluent discharges, littering, fishing, foreshore habitat protection, foreshore and waterway activities).	Capital work	NSW Maritime,	HSC (Estuary Unit), GCC, DECC, DPI fisheries, HNCMA	**Not Commenced / Outstanding**	Funding has been seek in the past – no support
34	2w	94	Install marker buoys and warnings around seagrass habitats to deter boaters from accessing and damaging these habitats	Capital work	NSW Maritime	HSC (Estuary Unit), GCC, DECC, DPI fisheries, HNCMA	**Completed**	Done around 3 patches of seagrass

Lower Hawkesbury Estuary Management Plan								
ID	**Strateg**	**Rank**	**Strategy**	**Category**	**Lead Responsibility**	**Support Responsibility**	**Status**	**Comments**
35	2x	136	Encourage the development and implementation of selective fishing gear, trawl practises/equipment and by-catch reduction devices amongst commercial fishers and researchers	Research	DPI Fisheries	HSC (Estuary Unit), GCC, DECC	**Implemented and Ongoing**	Work has been done; support for an EMS
36	3a	50	Restrict foreshore access in areas of high environmental sensitivity	Compliance	DECC, NSW DPI	HSC (Estuary Unit), GCC	**Implemented and Ongoing**	
38	3c	91	Rehabilitate recreational areas on the foreshore and implement Foreshore Annual Maintenance Program	Capital work	HSC (Works)	DECC, DoL, HSC (Estuary Unit), GCC	**Completed**	
39	4a	19	Ensure adequate waste disposal facilities for people aboard boats and recreational fishers on land. This includes installation/provision of approved bins on hireboats, commercial fishing boats, moored boats and trailable boats, and supporting waste services on land.	Capital wor	HSC (Waste Management), GCC	HSC(Estuary Unit)	**Implemented and Ongoing**	Cowan barge/rubbish in NPWS; Oceanwatch "Tangler" bin program; local bins in Brooklyn and Berowra Waters
40	4b	79	Initiate planning of the Lower Hawkesbury section of the Great Hawkesbury Walk.	Capital wor	DECC, HSC (Parks), GCC, Tourism NSW	DECC, HSC, GCC, Tourism NSW	**Not Commenced / Outstanding**	We have not looked onto his as much of the area is Nat Parks but it can stay in the new plan- to scope of the work
41	5a	20	Establish a regular monitoring program to monitor the impacts of recreation at various locations and times of year (such as peak periods), to ensure ongoing sustainability of such locations.	Research	HSC (Estuary Unit), GCC	NSW Department of Tourism, Sport and Recreation, DECC, NSW DPI	**In progress / Incomplete**	'Love the river campaign' More can be done
42	5b	46	Establish and implement one recreational water quality monitoring program (such as Beach/Streamwatch by EPA) for the entire Lower Hawkesbury.	Research	DECC	HSC (Estuary Unit), GCC	**Completed**	Swimming conditions reported daily; rec sites monitored in the past
43	5c	40	Undertake periodic mapping of aquatic habitats (including the extent and condition of benthic, intertidal zone, water column and water surface habitats) throughout the Lower Hawkesbury	Research	NSW DPI	DECC, HSC(Estuary Unit), GCC, HNCMA	**Completed**	Astles report; Macrophyte mapping done but needs to be checked. We need to improve mapping around Berowra Ck
44	5d	63	Develop key biological indicators and establish a biological monitoring program for aquatic and riparian habitats	Research	NSW DPI, HSC (Estuary Unit)	DECC, GCC, HNCMA	**Implemented and Ongoing**	Underwood studies; could do more in regards to macrophytes
45	5e	64	Develop a comprehensive ecosystem health water quality monitoring program across the Lower Hawkesbury	Research	NSW DPI, DECC, HSC (Estuary Unit)	DECC, GCC, HNCMA	**Completed**	OEH estuarine condition report health card; EcoHealth; Oyster health monitoring program
46	5f	87	Determine a set of parameters to indicate the progress in implementation of the EMP and to measure/indicate the effectiveness of actions in achieving EMP goals and protecting estuarine health.	Research	NSW DPI, DECC, HSC (Estuary Unit)	DECC, GCC, HNCMA	**Implemented and Ongoing**	Database – addressing strategies implemented
47	5g	92	Ensure monitoring programs are given a high priority to enable measurement of the effectiveness of the EMP.	Research	NSW DPI, DECC, HSC (Estuary Unit)	DECC, GCC, HNCMA	**Completed**	Whole of estuary approach to WQ health scores; long-term WQ report
48	6a	8	Minimise clearing of vegetation on privately owned land via new LEP template (eg Clause 5.9) and existing biodiversity strategy	Planning	HSC(Town Planning Services), HSC(Bushland and Biodiversity), GCC, DECC	HNCMA	**Implemented and Ongoing**	Effort inhibited by 10/50 legislation
49	6b	74	State government to develop stronger deterrents for failure to comply with planning controls and regulations	Planning	DoP	HSC(Assessments), GCC	**In progress / Incomplete**	More effort needed on this
50	6c	97	Enhance compliance with development consent conditions (sediment erosion controls, stormwater controls, permeable surface area, water reduction devices, urban design, vegetation removal etc). Increase and enforce penalties for non-compliance and unauthorised development (including renovations etc)	Planning	HSC (Assessments), GCC	DECC, HSC (Environmental Sustainability and Health)	**Implemented and Ongoing**	Very limited resources available for compliance activities
51	6d	47	Increase compliance with development consent conditions (such as for maintenance of stormwater devices, permeable surface area, water reduction devices, urban design, vegetation removal etc) over the long term (ie, in the years after completion of a development) to ensure such conditions continue to be met	Compliance	HSC (Assessments), GCC	DECC, HSC (Environmental Sustainability and Health)	**In progress / Incomplete**	Very limited resources available for compliance activities
52	6e	48	Increase the number of rural residential and smaller area landholders (less than 100 ha) attending management training for rural residential block and small farm management. The education should increase awareness of rural impacts on the estuarine environment, and provide solutions to manage such impacts.	Education	HNCMA	HSC (Bushland and Biodiversity), GCC	**Implemented and Ongoing**	
53	6f	49	Increase the area of non-urban land managed within its capability	Education	HNCMA	HSC (Bushland and Biodiversity), GCC	**Unknown**	
54	6g	67	Implement education strategy for commercial and industrial sectors of the catchment to increase awareness of their impact on estuarine environment, and provide solutions to mitigate such impacts	Education	HSC(Environmental Sustainability and Health), GCC	DECC, HNCMA	**Implemented and Ongoing**	Guided bushwalks- boat tours; env days; compliance audits

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ID	**Strateg**	**Rank**	**Strategy**	**Category**	**Lead Responsibility**	**Support Responsibility**	**Status**	**Comments**
55	6h	52	Educate residents as to best practise catchment management (fertilisers, chemicals, pesticides, threat of weeds to bushland, and encourage the removal of exotic species and replacement with suitable indigenous plants, domestic animals)	Education	HSC (Bushland and Biodiversity), GCC	DECC, HNCMA	**Implemented and Ongoing**	Environmental days
56	6i	145	Provide incentives for the establishment of riparian filters to treat run-off from areas which may generate potentially high pollutant loads in runoff (eg, livestock, turf farms etc)	Capital/On-g	DECC, NSW DPI Fisheries	HSC (Bushland and Biodiversity), GCC, HNCMA	**In progress / Incomplete**	Funds have been available through the CMA and we have used them in a few small areas but there are others we need to address- not many though as we have minimal areas with livestock/turf farm
57	6j	144	Undertake soil conservation works such as fencing, gully control structures, track/trail, fire trails and rural road stabilisation and revegetation to reduce soil erosion	Capital/On-g	HSC (Bushland and Biodiversity), GCC	DECC	**In progress / Incomplete**	More work can be done, collaborations with Soil Conservation/ MEMA..
58	7a	134	Investigate which zoning, in accordance with LEP standard instrument, offers greatest protection to Big Bay and Marramarra Creek and incorporate into new LEP	Planning	HSC(Town Planning Services), HSC(Estuary Unit), GCC	DECC, DoP	**Completed**	New land-use area W1 Natural Waterways, max protection
59	7b	84	Use recommendations made in the Hornsby Shire Waterways Review (SJB, 2006) to inform waterway zoning in new LEP for the Lower Hawkesbury	Planning	HSC (Estuary Unit)	HSC (Town Planning Services)	**Completed**	As per above 7a; W1 land-use to estuary
60	7c	39	Update existing boating maps (boat and PWC speeds, access, and vessel size limits in various zones) for the entire Lower Hawkesbury to reflect findings of bank erosion studies, significant aquatic and riparian habitats, priority harvest area requirements, and other relevant environmental studies	Education	NSW Maritime Authority, HSC (Estuary Unit)	DECC, DPI Fisheries, HSC(Estuary Unit),GCC	**In progress / Incomplete**	Mapping reflects macrophyte location but not erosion vulnerability areas
61	7d	119	Implement exclusion zones for recreational/private boating in specific oyster harvest area to protect sanitary water quality, using appropriate methods	Planning	NSW Maritime Authority	DPI Fisheries, HSC (Estuary Unit), GCC	**In progress / Incomplete**	Septic inspections? Nothing exists excluding rec boating
62	7e	99	Investigate innovative methods to restrict the numbers of boats or the size of vessels in areas of high environmental sensitivity/significance.	Planning	NSW Maritime Authority	DPI Fisheries, DECC, Council, HSC (Estuary Unit)	**Not Commenced / Outstanding**	Issue running lines across Bradleys Beach
63	7f	121	Ensure no net increase in existing moorings/berthings is permitted throughout the Lower Hawkesbury. Only permit additional berthings in marinas where they replace existing swing moorings.	Planning	NSW Maritime Authority	HSC(Estuary Unit and Town Planning Services), GCC, Stakeholders	**In progress / Incomplete**	Mooring numbers keep increasing; issue as number of boats keep increasing
64	7g	76	Progressively relocate or modify moorings considered to have a high environmental impact or are located in areas of high environmental significance or sensitivity.	Planning	NSW Maritime Authority	DPI Fisheries, HSC (Estuary Unit)	**Implemented and Ongoing**	Most moorings are located in low env impact areas but we still have boats on anchors
65	7h	118	Dredging of existing navigation channels is supported subject to appropriate environmental approvals	Planning	NSW Maritime Authority	DECC, DoL, HSC (Estuary Unit)	**Implemented and Ongoing**	Dredging currently happening in Parsley Bay; also looking at Brooklyn Harbour
66	7i	109	Enhance compliance activities and enforcement of penalties for all waterway regulations and consider increasing deterrents for non compliance with regulations (boat speed zones, effluent discharges, seagrass protection, littering, permanent occupation of boats, illegal overnight mooring of boats etc)	Compliance	NSW Maritime Authority	DPI Fisheries, Councils	**Implemented and Ongoing**	RMS needs to do more about this
67	7j	53	Develop and implement a program for auditing boats for methods used to contain waste from boat maintenance, effluent discharge practises, rubbish disposal, oil discharge from bilge pumps and all other environmental issues associated with boat usage. This could reasonably be combined with NSW Maritime audits of moorings.	Compliance	NSW Maritime Authority, HSC(Environmental Sustainability and Health), GCC	DECC, Councils	**In progress / Incomplete**	Would be interesting to see what RMS says about this. We have had conversations but have gone no where. Derelict boats are a major issue
68	7k	123	Develop a “River Code” which outlines acceptable boating activities/behaviour (focussing on environmental impacts) and includes updated boating maps. The “River Code” could incorporate existing NSW Maritime and other brochures relating to the environment and appropriate behaviour (boat speeds etc). Options for distribution of “River Code” should be considered (eg, stickers, with licence applications, broad advertising etc)	Education	NSW Maritime Authority	DPI Fisheries, DECC, Council, HSC (Estuary Unit)	**Implemented and Ongoing**	There have been a few campaigns but not many and not efficient
69	8a	148	Transfer the management of Kangaroo Point pumpout to an appropriate State government agency	Planning	HSC (Estuary Unit), GCC	NSW Maritime, DECC, DoL	**In progress / Incomplete**	No one wants to take this and the asset is getting old
70	8b	15	Provide an annual progress report which gives a review of monitoring data, progress in implementing EMP actions and outlines the status of estuarine health	Research	HSC (Estuary Unit), GCC	DECC, NSW Maritime, DoL, DPI Fisheries, HNCMA	**Completed**	Council used to provide annual report for estuary work but now we’ve moved to a report for the branch and through Delivery/Operation Program report/ online portals and data provision
71	8c	16	Undertake an independent review and update of the EMP every three years to continually improve performance in meeting the EMP objectives and protecting estuarine health	Research	HSC (Estuary Unit), GCC	DECC, NSW Maritime, DoL, DPI Fisheries	**Implemented and Ongoing**	We do reviews but we do not have a good method to measure performance except KPIs
72	8d	26	Provide a forum for discussion about issues relating to the estuary and EMP progress	Education	HSC (Estuary Unit), GCC	DECC, NSW Maritime, DoL, DPI Fisheries, HNCMA	**Implemented and Ongoing**	Lower Hawkesbury Estuary Management Plan Committee mainly
73	8e	137	Establish an MOU for data sharing (e.g. between SWC, NSW Food Authority, HSC, HNCMA, GSC, PC etc). Compile and manage a supporting database for the MOU for all monitoring data for the Lower Hawkesbury.	Research	HSC (Estuary Unit), GCC	DECC, NSW Maritime, DoL, DPI Fisheries, NSW Food Authority, HNCMA	**Completed**	MoU done and signed with neighboring council and Sydney Water; also MoU with Food Authority; Oyster growers…

Lower Hawkesbury Estuary Management Plan								
ID	**Strateg**	**Rank**	**Strategy**	**Category**	**Lead Responsibility**	**Support Responsibility**	**Status**	**Comments**
74	9a	11	Liaise with relevant state agencies to ensure integration of EMP actions into their relevant planning instruments/management plans/strategy activities (eg HNCMA's Catchment Action Plan, DPI Fisheries Sustainable Oyster Aquaculture Strategy etc)	Planning	HSC (Estuary Unit), GCC	DECC, NSW Maritime, DoL, DPI Fisheries, HSC (Town Planning Services) , HNCMA	**Implemented and Ongoing**	Through the LHEMP Committee; Oyster EMS; Commercial Fishers EMS
75	9b	9	Submit the EMP to appropriate Minister for gazettal by the NSW Government	Planning	HSC (Estuary Unit), GCC	DECC	**Not Commenced / Outstanding**	We decided not to follow this path
76	9c	12	Establish a Lower Hawkesbury estuary management committee to be facilitated by HNCMA which incorporates Pittwater, Gosford, Hornsby Councils for a coordinated approach to estuary management.	Planning	HNCMA	DECC, NSW Maritime, DoL, DPI Fisheries, HSC (Estuary Unit), GCC	**Completed**	LHEMP Committee created but not managed by CMA
77	9d	60	Investigate possibilities for involving universities, the CSIRO and/or other research organisations in research programs that implement actions within this plan (eg habitat mapping, biological monitoring program, etc.)	Research	HSC (Estuary Unit), GCC	DPI Fisheries, DECC, HNCMA	**Implemented and Ongoing**	HSC is very proactive in partnering with researchers – we have plenty of examples re habitat mapping; biological monitoring
78	9e	17	Lobby NSW State Government to appoint an Estuary Manager for entire Lower Hawkesbury, to administer and update existing management plans and access State, Federal and private industry funding sources, and to develop a Hawkesbury estuary management plan.	Capital/On-g	HSC (Estuary Unit), GCC (Integrated Planning), GCC (Open Space and Leisure)	HNCMA, DECC	**In progress / Incomplete**	Plenty of ideas but we have not pushed this idea except for now through the CMP development
79	10a	7	Incorporate Climate Change Strategy to mitigate local climate change impacts into planning instruments/ management plans/ strategy activities (ie with tools such as vulnerability maps)	Research	DECC	HSC (Estuary Unit), GSC, HNCMA, HSC (Bushland and biodiversity) ,	**Implemented and Ongoing**	Current Council strategies are looking into this but not before. Previously Council would have comment on plans and strategies from OEH
80	10b	18	Improve the understanding of local impacts which may arise from climate change (eg produce vulnerability maps) and the management responses to such impacts (changes to infrastructure, planning provisions etc)	Planning	HSC (Environmental Sustainability and Health), GCC	DoP, HSC (Bushland and Biodiversity)	**In progress / Incomplete**	Some research project undertaken by CSIRO to look at SLR but has not been taken to the next level; climate change strategy drafted recently with Council insurance company
81	10c	42	Through the estuary management program, investigate novel actions to reduce carbon emissions / aim toward carbon neutrality in undertaking estuary management tasks (eg, planting of trees to offset boat use when sampling, etc)	Research	HSC (Estuary Unit), GSC, HNCMA	DECC, HNCMA	**In progress / Incomplete**	Current project on 25,000 trees; some initiatives in council to reduce carbon emissions but not as offsets as such
82	10d	25	Develop a set of biological indicators (eg, food chain or structural biota) which will assist in measuring climate change impacts	Research	DECC	HSC (Estuary Unit), GSC, HNCMA, HSC (Bushland and biodiversity)	**Not Commenced / Outstanding**	We don't have any biological indicator as proxy for CC, just WQ monitoring
83	11a	24	Continue to lobby for reuse of water from STPs, to reduce freshwater demands in catchment	Research	DECC, Sydney Water	DECC, NSW Maritime, DoL, DPI Fisheries, HSC (Estuary Unit), GCC	**In progress / Incomplete**	Current topic among councilors; discussions with SW; this can be addressed as part of NSW Risk base framework by Sydney Water; we are also developing a Hornsby Water Sensitive Strategy- although completed
84	11b	38	Regulate surface and ground water extraction (through licences etc) based upon assessment of required environmental flows.	Planning	DECC, DWE	DEW, NSW Maritime, DoL, DPI Fisheries, DECC	**Unknown**	Regulated via NSW Government. How accurate the database is certainly questionable though (lots of bores without licenses). https://www.waternsw.com.au/customer-service/water-licensing/about-licences
85	11c	110	Develop and implement a plan of management to maintain sustainable environmental flows as a component of total water cycle management (based upon studies and modelling of sustainable flows).	Planning	DECC	HSC (Water Catchments), GCC, DPI Fisheries	**In progress / Incomplete**	
86	11d	37	Increase the uptake of water and energy reduction devices through greater planning controls, incentives, free water reduction audits for homes/businesses etc	Planning	DECC	Councils, NSW Maritime, DoL, DPI Fisheries	**Implemented and Ongoing**	Sustainability is big on this
87	11e	113	Implement re-use options (such as dual reticulation, drinking water or other system) for treated effluent from STPs and their reticulation systems (eg sewer mining)	Planning	Sydney Water	DECC, GCC, HSC (Town Planning Services)	**Implemented and Ongoing**	Rain harvest- re-use in ovals only not from STP or drinking
88	11f	58	Undertake a comprehensive environmental flows investigation for all tributaries to the Lower Hawkesbury. This should include determining groundwater and surface water extraction rates/volumes, contributions from all sources (urban runoff, STPs), and ecological flow requirements.	Capital work	Sydney Water	Councils, DECC, NSW Maritime, DoL, DPI Fisheries, HNCMA	**Not Commenced / Outstanding**	Min work on this; WQ might start looking at Radon as a proxy for ground water. NSW DPIE are reviewing the 1999 NSW Water Quality and Riverflow Objectives as part fo MEMA but not released publicly
89	12a	96	Ensure fishing practises and oyster growing practises avoid artificially attracting large numbers of birds into oyster harvest zones	Planning	DPI Fisheries	DECC	**Completed**	
90	12b	81	Declare all waterway area in the Lower Hawkesbury as a 'no discharge zone'	Planning	DECC	NSW Maritime Authority	**Not Commenced / Outstanding**	
91	12c	83	Extend regulations for holding tanks to both grey and black water for recreational and commercial vessels.	Planning	DECC	NSW Maritime Authority	**Not Commenced / Outstanding**	
92	12d	120	Lobby State government to increase deterrents for effluent discharges and other forms of pollution from vessels using the waterways.	Planning	HSC (Estuary Unit), GCC	DECC	**Not Commenced / Outstanding**	

Lower Hawkesbury Estuary Management Plan								
ID	**Strateg**	**Rank**	**Strategy**	**Category**	**Lead Responsibility**	**Support Responsibility**	**Status**	**Comments**
93	12e	108	Prepare and implement a strategy for pumpouts across the Lower Hawkesbury Estuary (eg public use of commercial pumpouts, installation of additional public pumpouts etc)	Planning	NSW Maritime	HSC (Estuary Unit), GCC	**In progress / Incomplete**	Pump-out provided; need for more pump-outs in the estuary but who is responsible for installing/ maintaining them?
94	12f	78	Provide incentives to install oil absorbant devices within bilge water holding tanks for all moored and berthed vessels.	Planning	NSW Maritime	HSC (Estuary Unit), GCC, HNCMA	**Not Commenced / Outstanding**	
95	12g	112	Review Emergency Spill Management Action Plans to ensure they are adequate to protect estuarine assets for all LGAs with Lower Hawkesbury waterway	Planning	DECC	HSC, GCC, NSW Maritime Authority	**Implemented and Ongoing**	
96	12h	98	Provide incentives (eg grants or services) for a routine pumpout service to riverside settlements	Planning	DECC	HSC, GCC, NSW Maritime Authority	**Implemented and Ongoing**	Considered and offered to river settlements but not taken up
97	12i	127	Develop a sewage management strategy for riverside settlements as part of the 'Sanitary Surveys' undertaken by NSW Food Authority with consideration given to eliminating sewage leaching to the estuary.	Planning	NSW Food Authority	DECC, HSC (Environmental Sustainability and Health), GCC	**Implemented and Ongoing**	A strategy was developed and direct harvest zones created but is an on-going issue
98	12j	139	Encourage Sydney Water to consider an assessment of alternatives for management of sewage at Brooklyn, including effluent reuse.	Planning	HSC (Estuary Unit), GCC	DECC, NSW DPI	**Implemented and Ongoing**	Sewer connection to main in Brooklyn done. Need to work on effluent reuse
99	12k	131	Ensure use of correct procedures for advising of algal blooms and marine pests (caulerpa, stingers etc) occurrence (such as through RACC)	Compliance	HSC (Estuary Unit), GCC, Sydney Water	DECC, DPI Fisheries, NSW Maritime Authority	**Implemented and Ongoing**	Protocols used all time
100	12l	124	Ensure compliance of correct waste disposal from Marinas and vessels	Compliance	NSW Maritime Authority	HSC (Environmental Sustainability and Health), GCC	**In progress / Incomplete**	
101	12m	32	Ensure all boating facilities (marinas, slipways, private boat sheds, ferries, boat ramps etc) have containment areas for boat operation and maintenance (especially anti-foul paints, fuel storage tanks) and use best practise methods for mitigating environmental impacts. Perform follow-up audits to ensure recommendations are completed.	Compliance	HSC(Environmental Sustainability and Health), GCC	HSC, GCC, DECC	**Unknown**	
102	12n	125	All Councils within the Lower Hawkesbury are to conduct Emergency spill management as per relevant Emergency Action Plan.	Compliance	HSC(Environmental Sustainability and Health), GCC		**Not Commenced / Outstanding**	Good idea to pass on to CMP
103	12o	65	Ensure all onsite septic systems throughout the catchment are audited for efficient operation and recommendations of audits enacted. Enforce penalties where correct operation and outcomes of audit are not enacted.	Compliance	HSC(Environmental Sustainability and Health), GCC	HSC (Estuary Unit)	**In progress / Incomplete**	Limited compliance resources available. We had a good audit system but stopped 4 years ago; community and residents are asking for this back
104	12p	132	Sydney Water to continue to inform Councils and appropriate estuary users when STP's begin bypassing.	Compliance	Sydney Water	HSC(Estuary Unit), GCC	**Completed**	
105	12q	133	Implement a program to audit private sewer connections (such as NSW Government's former "pipechecks" program) and ensure audit recommendations are enacted	Compliance	Sydney Water	HSC(Estuary Unit), GCC	**In progress / Incomplete**	Discussed a number of times; back on council and SW agendas; WQ monitoring looking at bacto during dry weather
106	12r	140	Reconsider licence conditions upon EPA licence renewals to reduce load of pollutant discharged	Compliance	DECC	HSC(Estuary Unit), GCC	**In progress / Incomplete**	
107	12s	115	Ensure compliance with greywater reuse policy (i.e. DWE and Council Policies)	Compliance	HSC(Environmental Sustainability and Health), GCC	DWE, DECC	**Implemented and Ongoing**	Although it is based on reactive complaints not proactive
108	12t	104	Audit commercial and industrial areas with regard to mitigating impacts on estuarine assets.	Compliance	HSC(Environmental Sustainability and Health), GCC	DECC	**Implemented and Ongoing**	Although it is based on reactive complaints not proactive
109	12u	142	Promote the use of oil absorbent devices for the removal of fuels and oils from bilge water	Education	HSC(Environmental Sustainability and Health), GCC	NSW Maritime Authority. DECC	**Not Commenced / Outstanding**	
110	12v	62	Provide information to residents to improve management of on-site sewage disposal, particularly in proximity to oyster harvesting areas, and on alternative disposal methods.	Education	HSC(Environmental Sustainability and Health), GCC	DECC, NSW DPI	**In progress / Incomplete**	
111	12w	41	Apply best practise stormwater management and asset management for stormwater infrastructure through preparation, implementation and regular review of stormwater management plans across the Lower Hawkesbury catchment.	Capital work	HSC(Works and Estuary Unit), GCC	DECC	**Implemented and Ongoing**	Working reasonably well
112	12x	82	Consider end of pipe treatment for all direct stormwater outlets to the estuary	Capital work	HSC(Catchment Remediation), GCC	DECC	**Implemented and Ongoing**	Some works implemented via Councils Catchment Remediation Rate funding (CRR program)
113	12y	127	Eliminate all sources of sewer overflows (including pumping stations, mushrooms, sewer chokes) in both dry and wet weather throughout the Lower Hawkesbury catchment.	Capital work	Sydney Water	HSC, GSC	**Implemented and Ongoing**	WQ program looking at this but we need to do more
114	12z	128	Continue to upgrade STP effluent quality to minimise pollutant loads and enable greater re-use	Capital work	Sydney Water	DECC	**Implemented and Ongoing**	

Lower Hawkesbury Estuary Management Plan								
ID	**Strateg**	**Rank**	**Strategy**	**Category**	**Lead Responsibility**	**Support Responsibility**	**Status**	**Comments**
115	12aa	117	Provide education to increase community acceptance of recycled water from STPs, and collection and re-use of stormwater, etc as per the Sustainable Total Water Cycle Management strategy	Education	HSC(Estuary Unit), GCC	Sydney Water	**Not Commenced / Outstanding**	
116	12bb	129	Investigate increasing wet weather capacity of STPs in catchment to ensure no bypassing during wet weather	Capital work	Sydney Water	DWE	**In progress / Incomplete**	
117	12cc	116	Install appropriate sewage disposal at public facilities located near waterways in the parks, reserves and foreshore recreational areas	Capital work	HSC(Parks), GCC	DoL	**Implemented and Ongoing**	Most spots covered, need toilet solutions at Kangaroo Point and Wisemans ferry
118	12dd	73	Investigate, and implement as appropriate, solid waste, green waste and recyclables collection for Riverside Settlements	Capital work	HSC(Waste Management), GCC	DECC	**In progress / Incomplete**	Some system in place- issue bulk waste
119	12ee	111	Ensure that all state-owned road and rail infrastructure within the catchment has adequate stormwater management for water quality and flows	Capital work	RailCorp, Roads and Traffic Authority	HSC(Estuary Unit), GCC	**Unknown**	
120	12ff	130	Ensure use of low residue herbicides and adopt practices to minimise input to the waterway	Capital work	HSC (Bushland and Biodiversity), GSC	DECC, DoL	**In progress / Incomplete**	Some education effort only at community level; Natural resources team advocates minimal use of herbicides by contractors and more hand-weed-pulling
121	12gg	143	Improve management of leachate and runoff from waste disposal sites	Capital work	HSC(Catchment remediation), GCC	DECC	**Implemented and Ongoing**	WQ covers tips and similar sites
122	12hh	13	Undertake remote and real time environmental monitoring for the Lower Hawkesbury (e.g. chlorophyll-a probes, wind speed probes, salinity, flow meters, satellite data), and make data available to the public.	Research	HSC(Estuary Unit), GCC	DECC	**Implemented and Ongoing**	We have a great system, working well; 2018 Green Globe Awards. https://www.mhlfit.net/users/HornsbyShireCouncil/
123	12ii	68	Investigate opportunities for allowing flushing under the causeway at Sandbrook Inlet	Research	HSC(Estuary Unit), GCC	DECC	**In progress / Incomplete**	Some hydrodynamic study done but more needs to be done
124	12jj	69	Determine sources of sediment contamination and impacts of contaminants on estuarine health, through sediment and water quality testing across the Lower Hawkesbury	Research	HSC(Estuary Unit), GCC	DECC	**Implemented and Ongoing**	Done every 5-7 years
125	12kk	54	Establish an ongoing sediment monitoring program for the estuary concentrating on areas of known heavy metal contamination or boat maintenance services.	Research	HSC(Estuary Unit), GCC	DECC	**Implemented and Ongoing**	As per above
126	12ll	126	Complete mapping of stormwater drainage system in all areas of the Lower Hawkesbury catchment and ensure maps are regularly updated	Research	HSC(Works), GCC	DECC	**Completed**	We have map from SW and Council
127	13a	27	Enhance weed management programs across catchment, particularly in estuarine vegetation	Capital work	DPI Fisheries, HNCMA	HSC(Estuary Unit), GCC, HSC (Bushland and biodiversity)	**Implemented and Ongoing**	Bushcare/Floating landcare effort plus contractors in estuarine sites
128	13b	28	Enhance existing pest eradication programs, particularly in estuarine habitats	Capital work	DPI Fisheries	HNCMA, DECC, HSC (Estuary Unit), GCC, HSC (Bushland and biodiversity)	**In progress / Incomplete**	Caulerpa, ornamental fish but we can do more
129	14a	93	Investigate the potential for increased sedimentation as a result of bushfires and prescribed burning	Research	HSC(Bushland and Biodiversity), GCC	HNCMA, DECC	**In progress / Incomplete**	Discussions have been held but no specific research on this- also need to look at the impact on algae blooms
130	14b	107	Determine sedimentation rates for the estuary as required.	Research	HSC(Estuary Unit), GCC	HNCMA, DECC	**Implemented and Ongoing**	Process study looked into this- we need updated info
131	14c	44	Prepare and implement creek rehabilitation plans to restore and maintain native vegetation in the riparian zone	Capital/On-g	HSC(Bushland and Biodiversity), GCC	HNCMA	**Implemented and Ongoing**	As part of estuarine site management by bushland team; also Ecohealth, CMA/LLS projects SaltPan; Seymours Ck,
132	15a	23	Consider a “Residents Pack” which outlines the estuary values, regional significance, ways to preserve such values, and includes existing brochures (from Councils, DPI Fisheries, NSW Maritime, NPWS etc) on stormwater, endemic plantings, bushcare, boating maps, seagrass maps, aquatic weeds, etc	Education	HSC(Estuary Unit), GCC	GSC, HNCMA, DECC, Maritime NSW, DPI Fisheries	**Implemented and Ongoing**	Living on the edge flyer to all residents; friendly seawall; material given in education events, boat tours
133	15b	21	Encourage vigilance in reporting non compliance with regulations and environmental conditions/degradation (eg, sediment erosion controls, OSSMs, vegetation removal/destruction, stormwater control and maintenance, recreational activities etc) and pollution incidents (e.g. algal blooms, oils spills, chemical spills etc) to appropriate authorities (e.g., “river hood watch program”)	Education	HSC(Estuary Unit), GCC	GSC, HNCMA, DECC, Maritime NSW, DPI Fisheries	**Implemented and Ongoing**	PFAS impact; boat wash to RMS; suspicious activates; spills to EPA and Food Authority
134	15c	75	Encourage local residents to participate in conservation and bush regeneration schemes	Education	HSC(Bushland and Biodiversity), GCC	HNCMA, DECC	**Implemented and Ongoing**	Guided bushwalks; bushcare; education talks
135	15d	36	Educate recreational users/general visitors about estuary values and the estuarine system, recreational impacts, and actions they may take to reduce impacts on priority areas (seagrass, harvest areas, recreational swimming) in the estuary (e.g. signage, boating stickers, brochures etc)	Education	HSC(Estuary Unit), GCC	GSC, HNCMA, DECC, Maritime NSW, DPI Fisheries	**Implemented and Ongoing**	Seagrass flyers; boating maps; info provided to schools

Lower Hawkesbury Estuary Management Plan								
ID	Strateg	Rank	Strategy	Category	Lead Responsibility	Support Responsibility	Status	Comments
136	15e	85	Provide a general understanding and appreciation of Aboriginal culture and occupation of the Lower Hawkesbury, within the parks, reserves and other foreshore recreational areas, with appropriate brochures, signage and interpretation programs.	Education	DECC	HSC(Bushland and Biodiversity), GCC, HNCMA	**Implemented and Ongoing**	Min info on guided bushwalks and other community events
137	15f	71	Participate in community events to highlight unique values of estuary and promote estuary management program	Education	HSC(Estuary Unit), GCC	HNCMA, DECC, Maritime NSW, DPI Fisheries	**Implemented and Ongoing**	Markest; community days; oyster field days; oceanwatch events
138	15g	135	Provide information about the estuary on the Internet through all local councils' home pages, and promote the estuaries website (www.estuary.hornsby.nsw.gov.au) and links between Councils websites for Lower Hawkesbury.	Education	HSC(Estuary Unit), GCC		**Implemented and Ongoing**	Info on website and social media – on-going updates
139	15h	88	Develop a schools estuarine education program, which includes a resource kit and practical experience in bush regeneration work, water quality monitoring and other tasks	Education	DECC, HSC (Estuary Unit)	HSC, GCC, HNCMA, DPI Fisheries	**Implemented and Ongoing**	School visits re seagrasses; tree planting (national tree day); clean-ups; education through Clean4Shore
140	15i	89	Investigate program of guided tours to promote education about the estuary	Education	DECC, HSC (Estuary Unit)	HSC, GCC, HNCMA, DPI Fisheries	**Implemented and Ongoing**	We do quite a lot of them
141	15j	86	Provide interpretive / heritage signage at strategic locations to explain key features, waterways and estuary significance	Capital/On-g	HSC(Estuary Unit), GCC	HNCMA, DECC, Maritime NSW, DPI Fisheries	**Implemented and Ongoing**	
142	16a	61	Establish MOU's (Memorandums of Understanding) between Council and universities and other research organisations to encourage research into the estuary	Planning	HSC(Estuary Unit), GCC	Universities, HNCMA, DPI Fisheries, DECC	**Completed**	Current MoU with oyster groups; neighboring councils; universities; Sydney Water; OEH science
143	16b	70	Develop a catchment and estuarine model to illustrate the interactions between the estuary and catchment influences	Research	HSC(Estuary Unit), GCC	DECC, HNCMA	**In progress / Incomplete**	We have developed conceptual models for algal species blooms but not for other WQ and catchment issues
144	16c	56	Undertake periodic surveys of the types, numbers and locations of various recreational activities on all foreshores and waterways of the Lower Hawkesbury.	Research	HSC(Estuary Unit), GCC	NSW Tourism, DECC, DPI Fisheries	**Implemented and Ongoing**	Few studies undertaken but we need more
145	16d	114	Undertake periodic survey of recreational and commercial fishers to determine volumes, species and locations of fish caught across the entire Hawkesbury Estuary	Research	DPI Fisheries	Commercial fishers, DECC, HSC (Estuary Unit)	**Implemented and Ongoing**	Fisheries have done fish stock assessments and get info about catch effort
146	16e	66	Undertake research into the impact of catch numbers, trawl methods (such as otter boards) and other influences on the long term sustainability of all fish species (target and non-target) in the Hawkesbury Estuary	Research	DPI Fisheries	Commercial fishers, DECC, HSC (Estuary Unit)	**Implemented and Ongoing**	Fisheries have done some of these studies
147	16f	43	Undertake a study to identify locations of bank erosion in the estuary and determine the causes of such erosion (e.g., wind waves, boat wake) and remediate as required	Research	HSC(Estuary Unit), GCC	DECC, Maritime NSW, HNCMA	**Implemented and Ongoing**	Undertaken between Wiseemans Ferry and Spencer both shorelines
148	16g	55	Determine physical processes (hydrodynamics) of the estuary using in stream flow gauges, bathymetric survey etc	Research	HSC(Estuary Unit), GCC	DECC, Maritime NSW	**Implemented and Ongoing**	There is some monitoring but we need more flow gauges and rainfall gauges

Pearl Beach Lagoon Coastal Zone Management Plan					
ID	Action	Lead Responsibilities	Support Responsibilities	Status	Comments
1	Provide information to the community	Council	Pearl Beach Progress Association, Bush care, Catchment Management Body/Local Land Services	**Implemented and Ongoing**	Plan was developed in close consultation with the community. Additional community consultation to be undertaken as part of the implementation of the plan.
2	Prepare a vegetation and access master plan	Council	OEH, Catchment Management Authority / Local Land Services	**Not Commenced / Outstanding**	
3	Works staff and contractor training program	Council	Council contractors	**Not Commenced / Outstanding**	
4	Retrofit stormwater quality improvement measures	Council	NSW Office of Water	**In progress / Incomplete**	
5	Rehabilitate habitats within creek lines of the catchment	Council	NSW Office of Water	**Implemented and Ongoing**	Habitat restoration works on-going around the lagoon as part of the volunteer Landcare program.
6	Improved compliance for construction activities	Council		**Implemented and Ongoing**	Compliance is BAU. Councils education unit has rolled out a number of education programs regarding erosion and sediment control targeting contractors.
7	Include Pearl Beach Lagoon in council overall Lagoon Opening Policy and Procedure	Council		**In progress / Incomplete**	Review complete, awaiting completion of flood risk studies for various catchments prior to finalisation of policy.
8	Investigate options to modify the weir	Council		**In progress / Incomplete**	
9	Investigate options for removing material from lagoon bed	Council, OEH, RMS		**In progress / Incomplete**	

Gosford Beaches Coastal Zone Management Plan						
ID	**Location**	**Precinct**	**Action**	**Responsibility**	**Status**	**Comments**
PA1	Patonga Beach	Precint 1	Monitor performance of erosion protection works and monitor beach profile at main carpark (fronting the shops)	Council	**Implemented and Ongoing**	Biannual LiDAR surveys undertaken along Patonga Beach. Erosion protection works monitored in accordance with Asset Management protocols.
PA2	Patonga Beach	Precint 1	Repair damage to carpark should storm erosion occur	Council	**Implemented and Ongoing**	Implemented on an "as needs" basis in response to storm events
PA3	Patonga Beach	Precint 1	Investigate feasibility of placement of sand sourced from western beach and shoals at creek entrance to provide buffer against storm erosion	Council	**Not Commenced / Outstanding**	
PA4	Patonga Beach	Precint 1	Beach scraping	Council	**Not Commenced / Outstanding**	
PA5	Patonga Beach	Precint 1	Future relocation of carpark and associated infrastructure to an area landward of the coastal hazard area	Council	**Not Commenced / Outstanding**	Unlikely to politically palitable in the short to medium term.
PA6	Patonga Beach	Precint 1	Stabilisation of dunes in with vegetation and fencing	Council	**Not Commenced / Outstanding**	
PA7	Patonga Beach	Precint 1	Monitor and assess existing erosion protection works	Council	**Implemented and Ongoing**	Erosion protection works monitored in accordance with Asset Management protocols.
PA8	Patonga Beach	Precint 1	Relocate access road as erosion occurs	Council	**Not Commenced / Outstanding**	Unlikely to politically palitable in the short to medium term.
PA9	Patonga Beach	Precint 1	Periodic nourishment of area with sand sourced from Patonga Creek entrance	Council, OEH, RMS	**Not Commenced / Outstanding**	
PA10	Patonga Beach	Precint 1	Monitor beach profiles	Council, OEH, RMS	**Implemented and Ongoing**	Biannual LiDAR surveys undertaken along Patonga Beach.
PA11	Patonga Beach	Precint 1	Upgrade seawall	DoI - Lands	**Completed**	
PA12	Patonga Beach	Precint 1	Ensure floor levels for new Development Applications are above inundation levels	Council	**Implemented and Ongoing**	Development Assessment process.
PA13	Patonga Beach	Precint 1	Upload flood/inundation information onto Council's website for access by property owners	Council	**In progress / Incomplete**	Refer to link to flood mapping tool below: https://www.centralcoast.nsw.gov.au/environment/bushfires-and-flooding/preparing-flood-emergencies Latest inundation information may not be uploaded.
PA14	Patonga Beach	Precint 1	Beach scraping and dune management to maintain crest level of dune above wave runup level	Council	**Not Commenced / Outstanding**	Scraping generally undertaken in response to erosion events in locations where beach recovery has not occurred and the verticle scarp poses a risk to the public. These conditions have not yet occured at Patonga and as such scraping has not been necessary to date. Patonga dunes were not at top of priroty list for Council funded works. Additonally, there are no active Landcare groups in the location.
PA15	Patonga Beach	Precint 1	Continue and enhance dune vegetation management - Assist/encourage community groups with dune management actions including Dunecare/Bushcare	Council	**Not Commenced / Outstanding**	Patonga dunes were not at top of priroty list for Council funded works. Additonally, there are no active Landcare groups in the location.
PA16	Patonga Beach	Precint 1	Undertake survey of floor levels of existing buildings	Council	**Unknown**	Awaiting advice from flood planners.
PA17	Patonga Beach	Precint 1	Monitor and assess existing erosion protection works	Council	**Unknown**	This action referes to erosion protection works in front of the Dark Corner cottages. This is a Crown Land responsibility.
PA18	Patonga Beach	Precint 1	Implement erosion control works in front of cottages in accordance with Patonga Draft Plan of Management Crown Reserves and Dark Corner Cottages 2013	DoI - Lands	**Completed**	Details would need to be obtained from Crown Lands.
PA19	Patonga Beach	Precint 1	Investigate periodic maintenance dredging of sand from the creek entrance	OEH	**Not Commenced / Outstanding**	

Gosford Beaches Coastal Zone Management Plan						
ID	***Location***	***Precinct***	***Action***	***Responsibility***	***Status***	***Comments***
PA20	Patonga Beach	Precint 1	Investigate lengthening existing entrance breakwater	Council, OEH	**Not Commenced / Outstanding**	
PA21	Patonga Beach	Precint 1	Investigate installation of stormwater energy dissipation to reduce discharge velocities at outlet	Council	**Not Commenced / Outstanding**	
PA22	Patonga Beach	Precint 1	Post storm beach scraping to assist natural recovery of the dune and repair scour caused by stormwater discharge	Council	**Not Commenced / Outstanding**	Scraping generally undertaken in response to erosion events in locations where beach recovery has not occurred and the verticle scarp poses a risk to the public. These conditions have not yet occured at Patonga and as such scraping has not been necessary to date.
PA23	Patonga Beach	Precint 1	Complete a vegetation profile for Patonga Beach and support the natural vegetation profile.	Council	**Completed**	Vegetation mapping for Central Coast LGA has been updated.
PA24	Patonga Beach	Precint 1	Erosion protection works to be allowed for properties	Council	**Unknown**	Private protection works subject to Part 4 development application process.
PA25	Patonga Beach	Precint 1	Investigate feasibility of swimming enclosure at Patonga	Council	**Not Commenced / Outstanding**	
PE1	Pearl Beach	Precinct 1	Erosion Protection works to be allowed for four properties south of Green Point Creek entrance as well as for sewage pumping station and sewer line at end of Gem Road and south from Gem Road extending to protect infrastructure	Council, NSW Govt., landowners	**Not Commenced / Outstanding**	
PE2	Pearl Beach	Precinct 1	Monitor performance of existing erosion works at properties south of Green Point Creek entrance	Council	**No Longer Applicable**	Existing protection works on private property are the responsibility of private landowners.
PE3	Pearl Beach	Precinct 1	Relocate sewer infrastructure and pumping station further landward	Council	**Not Commenced / Outstanding**	
PE4	Pearl Beach	Precinct 1	Investigate feasibility/sources of sand for beach nourishment	Council, OEH	**Not Commenced / Outstanding**	
PE5	Pearl Beach	Precinct 1	Beach scraping to build dune in front of residences, Gem Road and restaurant	Council, OEH	**Not Commenced / Outstanding**	Scraping generally undertaken in response to erosion events in locations where beach recovery has not occurred and the verticle scarp poses a risk to the public. These conditions have not yet occured along this section of Pearl Beach and as such scraping has not been necessary to date.
PE6	Pearl Beach	Precinct 1	Erosion protection works to be allowed for properties	Local landowners, Council/Coastal Panel for DA assessment	**Unknown**	Private protection works subject to Part 4 development application process.
PE7	Pearl Beach	Precinct 1	Continue dune vegetation management - Assist/encourage community groups with dune management actions including Dunecare/Bushcare	Council, OEH	**Implemented and Ongoing**	Dune care group active at various locations long the length of Pearl Beach.
PE8	Pearl Beach	Precinct 1	Develop entrance management guidelines for mechanical opening of Green Point Creek	Council	**In progress / Incomplete**	Review of entrance management protocols has been completed. Awaiting completion of various flood studies before development of new entrance management policy.
PE9	Pearl Beach	Precinct 1	Development controls as per existing DCP i.e. defined building line with new buildings to be founded into 2100 Stable foundation Zone. Residences and restaurant to be above inundation levels on redevelopment of propertie	Council	**Completed**	Development controls are included in section 6.2 Coastal Frontage of the Gosford DCP 2013.
PE10	Pearl Beach	Precinct 1	Investigate “tripper” structure to control opening location of creek	Council	**Not Commenced / Outstanding**	
PE11	Pearl Beach	Precinct 1	Identify floor levels to determine degree of inundation hazard	Council	**Unknown**	Awaiting advice from flood planners.
PE12	Pearl Beach	Precinct 1	Complete a vegetation profile for Pearl Beach and support the natural vegetation profile.	Council, Dunecare	**Completed**	Vegetation mapping for Central Coast LGA has been updated.
PE13	Pearl Beach	Precinct 1	Monitor rock pool for storm damage and repair if required	Council	**Implemented and Ongoing**	as needs

Gosford Beaches Coastal Zone Management Plan						
ID	*Location*	*Precinct*	*Action*	*Responsibility*	*Status*	*Comments*
PE14	Pearl Beach	Precinct 2	Repair of playground area, toilet block, beach accessways and landscaping works following erosion in a large storm event	Council	**Implemented and Ongoing**	as needs
PE15	Pearl Beach	Precinct 2	Beach scraping following storm event to build dune crest level and revegetation	Council	**Not Commenced / Outstanding**	Scraping generally undertaken in response to erosion events in locations where beach recovery has not occurred and the verticle scarp poses a risk to the public. These conditions have not yet occured along this section of Pearl Beach and as such scraping has not been necessary to date.
PE16	Pearl Beach	Precinct 2	Continue dune vegetation management - Assist/encourage community groups with dune management actions including Dunecare/Bushcare	Council	**Implemented and Ongoing**	Dune care group active at various locations long the length of Pearl Beach.
PE17	Pearl Beach	Precinct 2	Develop entrance management guidelines for mechanical opening of Middle Creek	Council	**In progress / Incomplete**	Review of entrance management protocols has been completed. Awaiting completion of various flood studies before development of new entrance management policy.
PE18	Pearl Beach	Precinct 2	Long term removal and relocation of playground should erosion escarpment move landward in future	Council	**Not Commenced / Outstanding**	Has not been necessary to date.
PE19	Pearl Beach	Precinct 2	Future installation of erosion protection works once erosion escarpment reaches set trigger distance from road edge; or Future closure of road and installation of alternative access (e.g. rear lane access to properties along Pearl Parade)	Council	**Not Commenced / Outstanding**	Has not been necessary to date.
PE20	Pearl Beach	Precinct 2	Repair and restoration of Pearl Parade should it be damaged by a future storm	Council,OEH,RMS	**Not Commenced / Outstanding**	Has not been necessary to date.
PE21	Pearl Beach	Precinct 2	Landward relocation of water supply and electricity should it be damaged by future erosion	Council,OEH,RMS	**Not Commenced / Outstanding**	Has not been necessary to date.
PE22	Pearl Beach	Precinct 2	Development controls as per existing DCP i.e. defined building line for this section of beach with new buildings to be founded into 2100 Stable foundation Zone	Council	**Completed**	Development controls are included in section 6.2 Coastal Frontage of the Gosford DCP 2013.
PE23	Pearl Beach	Precinct 2	Monitor performance, upgrade/repair existing erosion protection works at the restaurant	Council	**Unknown**	Maitenance/Upgrade of private protection works are the responsibility of the landowner, not Council.
PE24	Pearl Beach	Precinct 3	Encourage and assist Dunecare group to maintain and revegetate dune after a storm	Council	**Implemented and Ongoing**	Dune care group active at various locations long the length of Pearl Beach.
PE25	Pearl Beach	Precinct 3	Post storm beach scraping to assist natural recovery of the dune and repair scour caused by breakout from Pearl Beach Lagoon and Middle Creek	Council	**Not Commenced / Outstanding**	Scraping generally undertaken in response to erosion events in locations where beach recovery has not occurred and the verticle scarp poses a risk to the public. These conditions have not yet occured along this section of Pearl Beach and as such scraping has not been necessary to date.
PE26	Pearl Beach	Precinct 3	Formalise entrance management guidelines for mechanical opening of Middle and Pearl Beach Lagoon entrances	Council	**In progress / Incomplete**	Review of entrance management protocols has been completed. Awaiting completion of various flood studies before development of new entrance management policy.
PE27	Pearl Beach	Precinct 3	Monitor effectiveness of concrete wall on northern bank of outlet	Council	**Unknown**	Responsibility for this asset yet to be determined. It is believed that informal inspections are undertaken from time to time however I have not been able to locate any documentation.
PE28	Pearl Beach	Precinct 3	Continue dune vegetation management - Assist/encourage community groups with dune management actions including Dunecare/Bushcare	Council, OEH	**Implemented and Ongoing**	Dune care group active at various locations long the length of Pearl Beach.
PE29	Pearl Beach	Precinct 4	Development controls as per existing DCP i.e. defined building line with new buildings to be founded into 2100 Stable foundation Zone	Council	**Completed**	Development controls are included in section 6.2 Coastal Frontage of the Gosford DCP 2013.
PE30	Pearl Beach	Precinct 4	Post storm beach scraping to assist natural recovery of dune	Council	**Implemented and Ongoing**	Scraping undertaken in response to April 2015 storm. Not required since.
PE31	Pearl Beach	Precinct 4	Investigate feasibility of terminal protection e.g. once erosion escarpment reaches trigger distance from defined building line	Council	**Not Commenced / Outstanding**	
PE32	Pearl Beach	Precinct 4	Encourage and assist Dunecare group to maintain and revegetate dune after a storm using appropriate endemic vegetation	Council	**Implemented and Ongoing**	Dune care group active at various locations long the length of Pearl Beach.

Gosford Beaches Coastal Zone Management Plan						
ID	**Location**	**Precinct**	**Action**	**Responsibility**	**Status**	**Comments**
PE33	Pearl Beach	Precinct 4	Investigate beach nourishment to increase buffer against storm erosion	Council	**Not Commenced / Outstanding**	
PE34	Pearl Beach	Precinct 4	Erosion protection works to be allowed for properties	Council	**Unknown**	Private protection works subject to Part 4 development application process.
PE35	Pearl Beach	Precinct 4	Post storm beach scraping to assist natural recovery of dune and to maintain crest level of dune above wave runup level	Council	**Implemented and Ongoing**	Scraping undertaken in response to April 2015 storm. Not required since.
PE36	Pearl Beach	Precinct 4	Encourage beachfront residents to maintain crest level of dune and vegetate dune on private property in accordance with dune management practice (e.g. community education, provision of free plants)	Council	**Not Commenced / Outstanding**	
PE37	Pearl Beach	Precinct 4	Development controls as per existing DCP i.e. requirement for floor levels to be above wave runup level and be compatible with inundation hazard	Council	**Completed**	Development controls are included in section 6.2 Coastal Frontage of the Gosford DCP 2013.
O1	Ocean Umina Beach	Precinct 1	Erosion Protection works to be allowed for four properties and carpark south of Ettalong Creek entrance	Council, OEH, Landowners	**Unknown**	Private protection works subject to Part 4 development application process.
O2	Ocean Umina Beach	Precinct 1	Monitor performance of existing training wall works along northern side of Ettalong Creek entrance	Council	**Implemented and Ongoing**	Monitoring in accordance with asset management procedures.
O3	Ocean Umina Beach	Precinct 1	Monitor storm run-up levels and dune erosion	Council	**Implemented and Ongoing**	Biannual LiDAR surveys undertaken along Ocean/Umina Beach.
O4	Ocean Umina Beach	Precinct 1	Future relocation of residence on No.8 Berrima Crescent landward of immediate hazard area within same lot on redevelopment if revetment wall is not constructed	Council	**Not Commenced / Outstanding**	
O5	Ocean Umina Beach	Precinct 1	Investigate feasibility of beach nourishment	Council	**Not Commenced / Outstanding**	Not considered for the far western end of the embayment at this stage.
O6	Ocean Umina Beach	Precinct 1	Beach scraping to build dune in front of residences at Berrima Crescent	Council	**Implemented and Ongoing**	A small amount of scraping has been conducted
O7	Ocean Umina Beach	Precinct 1	Encourage and assist Dunecare group to improve dune vegetation management using appropriate endemic vegetation and consolidation of beach access at southern end of beach	Council	**Implemented and Ongoing**	Dune restoration works are on-going along the beach.
O8	Ocean Umina Beach	Precinct 1	Develop entrance management guidelines for mechanical opening of Ettalong Creek	Council	**In progress / Incomplete**	Review of entrance management protocols has been completed. Awaiting completion of various flood studies before development of new entrance management policy.
O9	Ocean Umina Beach	Precinct 1	Voluntary purchase of portion of at risk property	Council, NSW Govt., landowners	**Not Commenced / Outstanding**	
O10	Ocean Umina Beach	Precinct 1	Development controls on redevelopment of properties within hazard area	Council, Landowners	**Completed**	Development controls are included in section 6.2 Coastal Frontage of the Gosford DCP 2013.
O11	Ocean Umina Beach	Precinct 1	Construct “tripper” structure to control opening location of creek	Council	**Not Commenced / Outstanding**	
O12	Ocean Umina Beach	Precinct 1	Development controls for residences to be above inundation levels on redevelopment of properties	Council	**Completed**	Development controls are included in section 6.2 Coastal Frontage of the Gosford DCP 2013.
O13	Ocean Umina Beach	Precinct 2	Monitor existing erosion protection works in front of surf club	Council, OEH, SLSC	**Unknown**	
O14	Ocean Umina Beach	Precinct 2	Monitor storm run-up levels and dune erosion	Council, SLSC	**Implemented and Ongoing**	Biannual LiDAR surveys undertaken along Umina/Ocean Beach.
O15	Ocean Umina Beach	Precinct 2	Repair of beach accessways and revegetation of dune following erosion in a large storm event	Council, OEH	**Implemented and Ongoing**	As needs. BAU.
O16	Ocean Umina Beach	Precinct 2	Beach scraping following storm events to build dune crest level and revegetation	Council	**Implemented and Ongoing**	Beach scraping undertaken periodically in response to significant events in 2015 and 2016.
O17	Ocean Umina Beach	Precinct 2	Install sand trapping fencing or other appropriate controls in beach access points where sand blowout occurs and in the vicinity of the SLSCs.	Council, Dunecare	**Implemented and Ongoing**	As needs. BAU.
O18	Ocean Umina Beach	Precinct 2	Complete a vegetation profile for Umina and Ocean Beach and support the natural vegetation profile.	Council, Dunecare	**Completed**	Vegetation mapping for Central Coast LGA has been updated.

Gosford Beaches Coastal Zone Management Plan						
ID	*Location*	*Precinct*	*Action*	*Responsibility*	*Status*	*Comments*
O19	Ocean Umina Beach	Precinct 2	Increase information signage near surf clubs on the ecology and history of Umina/Ocean Beach	Council	**Completed**	Signage pertaining to beach morphology and sediment dynamics installed.
O20	Ocean Umina Beach	Precinct 2	Improve shade areas around the grassed areas and car parks near the SLSCs	Council	**Not Commenced / Outstanding**	
O21	Ocean Umina Beach	Precinct 2	Maintain current signage and facilities on a regular basis	Council	**Implemented and Ongoing**	On-going maintenance
O22	Ocean Umina Beach	Precinct 2	Encourage and assist Dunecare group to maintain and revegetate dune after a storm using appropriate endemic vegetation	Council, OEH	**Implemented and Ongoing**	Two active bushcare groups work along Umina-Ocean Beach.
O23	Ocean Umina Beach	Precinct 2	Development of local area (Umina/Ocean Beach) online fact sheets and encourage local educational programs in schools regarding the dunes	Council, OEH	**Not Commenced / Outstanding**	
O24	Ocean Umina Beach	Precinct 2	Work with the Central Coast Surf Life Saving organisation to look at ways to support Surf Life Savings Australia's EcoSurf policy in the region – including Ocean and Umina Surf Life Saving clubs.	Council	**Unknown**	
O25	Ocean Umina Beach	Precinct 3	Monitor existing erosion protection works in front of surf club	Council, OEH, SLSC	**Implemented and Ongoing**	
O26	Ocean Umina Beach	Precinct 3	Monitor storm run-up levels and dune erosion	Council, SLSC	**Implemented and Ongoing**	Biannual LiDAR surveys undertaken along Umina/Ocean Beach.
O27	Ocean Umina Beach	Precinct 3	Repair of beach accessways and revegetation of dune following erosion in a large storm event	Council, OEH	**Implemented and Ongoing**	As needs. BAU.
O28	Ocean Umina Beach	Precinct 3	Repair of beach accessways and revegetation of dune following erosion in a large storm event	Council	**Implemented and Ongoing**	As needs. BAU.
O29	Ocean Umina Beach	Precinct 3	Install sand trapping fencing or other appropriate controls in beach access points where sand blowout occurs and in the vicinity of the SLSCs.	Council, Dunecare	**Implemented and Ongoing**	As needs. BAU.
O30	Ocean Umina Beach	Precinct 3	Encourage and assist Dunecare group to improve dune vegetation management using appropriate endemic vegetation and consolidation of beach access	Council, OEH	**Implemented and Ongoing**	Two active bushcare groups work along Umina-Ocean Beach.
O31	Ocean Umina Beach	Precinct 3	Investigate installation of stormwater energy dissipation to reduce discharge velocities at outlet	Council	**In progress / Incomplete**	Under consideration as part of the Umina-Ocean Beach Erosion Management Strategy
O32	Ocean Umina Beach	Precinct 3	Post storm beach scraping to assist natural recovery of the dune and repair scour caused by stormwater discharge	Council	**Implemented and Ongoing**	As needs. BAU.
O33	Ocean Umina Beach	Precinct 3	Increase information signage near surf clubs on the ecology and history of Umina/Ocean Beach	Council	**Completed**	Signage pertaining to beach morphology and sediment dynamics installed.
O34	Ocean Umina Beach	Precinct 3	Improve shade areas around the grassed areas and car parks near the SLSCs	Council	**Not Commenced / Outstanding**	
O35	Ocean Umina Beach	Precinct 3	Maintain current signage and facilities on a regular basis	Council	**Implemented and Ongoing**	As needs. BAU.
O36	Ocean Umina Beach	Precinct 3	Construction of a disabled beach access point outside Ocean Beach SLSC	Council	**No Longer Applicable**	Disabled access installed at Umina SLSC. Ocean Beach SLSC not suitable as beach profile is too steep.
O37	Ocean Umina Beach	Precinct 3	Encourage and assist Dunecare group to maintain and revegetate dune after a storm using appropriate endemic vegetation	Council	**Implemented and Ongoing**	Two active bushcare groups work along Umina-Ocean Beach.
O38	Ocean Umina Beach	Precinct 3	Development of local area (Umina/Ocean Beach) online fact sheets and encourage local educational programs in schools regarding the dunes	Council, OEH	**Not Commenced / Outstanding**	
O39	Ocean Umina Beach	Precinct 3	Work with the Central Coast Surf Life Saving organisation to look at ways to support Surf Life Savings Australia's EcoSurf policy in the region – including Ocean and Umina Surf Life Saving clubs.	Council	**Unknown**	
O40	Ocean Umina Beach	Precinct 4	Monitor storm run-up levels and dune erosion	Council, SLSC	**Implemented and Ongoing**	Biannual LiDAR surveys undertaken along Umina/Ocean Beach.
O41	Ocean Umina Beach	Precinct 4	Repair of beach accessways and revegetation of dune following erosion in a large storm event	Council, Dunecare	**Implemented and Ongoing**	As needs. BAU.
O42	Ocean Umina Beach	Precinct 4	Beach scraping following storm event to build dune crest level and revegetation	Council	**Implemented and Ongoing**	As needs. BAU.

Gosford Beaches Coastal Zone Management Plan						
ID	**Location**	**Precinct**	**Action**	**Responsibility**	**Status**	**Comments**
O43	Ocean Umina Beach	Precinct 4	Collapse steep eroded escarpment and revegetate following erosion events	Council	**Implemented and Ongoing**	As needs. BAU.
O44	Ocean Umina Beach	Precinct 4	Investigate feasibility of beach nourishment to increase erosion buffer at Ettalong Point	Council	**In progress / Incomplete**	Under consideration as part of the Umina-Ocean Beach Erosion Management Strategy
O45	Ocean Umina Beach	Precinct 4	Undertake erosion protection works to protect The Esplanade at Ettalong Point	Council, OEH	**In progress / Incomplete**	Under consideration as part of the Umina-Ocean Beach Erosion Management Strategy
O46	Ocean Umina Beach	Precinct 4	Encourage and assist Dunecare group to improve dune vegetation management using appropriate endemic vegetation and consolidation of beach access	Council, OEH	**Implemented and Ongoing**	Two active bushcare groups work along Umina-Ocean Beach.
O47	Ocean Umina Beach	Precinct 4	Investigate installation of stormwater energy dissipation to reduce discharge velocities at stormwater outlets	Council	**In progress / Incomplete**	Under consideration as part of the Umina-Ocean Beach Erosion Management Strategy
O48	Ocean Umina Beach	Precinct 4	Post storm beach scraping to assist natural recovery of the dune and repair scour caused by stormwater discharge	Council	**Implemented and Ongoing**	As needs. BAU.
O49	Ocean Umina Beach	Precinct 4	Development of local area (Umina/Ocean Beach) online fact sheets and encourage local educational programs in schools regarding the dunes	Council, OEH	**Not Commenced / Outstanding**	

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
C01	Water and Sediment Quality	Continue program of auditing to ensure best management practices for marinas around Brisbane Water Estuary. DECC's brochure Environmental Action for Marinas, Boatsheds and Slipways (2007) should be provided to marine operators.	All marinas	OEH, NSW Maritime	GCC	**In progress / Incomplete**	
C02		Provide additional resources for Council officers to undertake audits of properties to ensure enforcement of policies and conditions of consent relating to water quality during both the construction and operational phases.	Catchment-wide	GCC		**Implemented and Ongoing**	Commenced and ongoing. Mandatory stage inspections occur for Council certified/approved works to ensure development is aligned to conditions of consent. For WQ sediment and erosion controls monitored and ensure roof water connected. For complaints where development has been externally certified are responded to by Council on receipt of complaint.
C03	Water and Sediment Quality	Work with private land holders / tenants to improve stormwater management practices in the industrial estate near Hawk Street.	Kincumber	GCC	OEH	**Implemented and Ongoing**	Clean industry inspections focusing on education and compliance of industrial areas are undertaken periodically.
C04	Habitat and Species Conservation	Ensure ongoing enforcement of fishing regulations.	Waterway-wide	DPI (Fisheries)	Fishcare Volunteers	**Implemented and Ongoing**	Commenced and ongoing. Enforcement ongoing via NSW Fisheries officers who undertake compliance activities for both habitat protection and recreational fishing activity.
C05	Habitat and Species Conservation	Ensure the ongoing enforcement of Council's Tree Vandalism Policy. Reference should also be made to D6.44 Landscape and Vegetation Management Policy.	LGA-wide	GCC		**Implemented and Ongoing**	Commenced and ongoing.
C08	Recreational Usage	Enforce boating regulations (particularly speed restrictions and zoning of activities) within Brisbane Water.	Waterway-wide	NSW Maritime		**Implemented and Ongoing**	Commenced and ongoing.
C10	Recreational Usage	Enforce on-leash dog walking in restricted areas in line with Council's Dog Policy Review.	Catchment-wide	GCC		**Implemented and Ongoing**	Commenced and ongoing. Greater support from compliance required to properly address this issue.
C12	Recreational Usage	Investigate options for either banning or further limiting the use of jet skis in Brisbane Water Estuary.	Waterway-wide	NSW Maritime	GCC	**Implemented and Ongoing**	RMS has increased patrols for PWC compliance in Brisbane Water including targeted PWC compliance during safety campaigns in December 2015, January 2016 & March 2016. The safety campaigns consist of an educational phase coupled with media releases followed by a compliance phase. RMS also provided a dedicated telephone reporting line for PWC complaints during the recent boating season from December 2015 to March 2016.
C13	Foreshore Development	Provide additional resources for enforcement of compliance with foreshore development controls.	LGA-wide	GCC		**Implemented and Ongoing**	Commenced and ongoing. Mandatory stage inspections occur for Council certified/approved works to ensure development is aligned to conditions of consent. For WQ sediment and erosion controls monitored and ensure roof water connected. External complaints where development has been externally certified are responded to by Council on receipt of complaint.
C14	Foreshore Development	Audit existing foreshore development (including property boundaries, fences and other structures, boat houses, boat ramps, jetties, etc.) and identify illegal or non-conforming development for retrospective enforcement of development controls. This should be undertaken in accordance with the Conditions of Consent and relevant policy in force at the time of Development Approval. Where foreshore structures are negatively impacting on estuarine processes (e.g. causing erosion or accretion on adjacent lands), investigate opportunities to mitigate these issues. This may be achieved through the Crown lands lease/licensing mechanism (where relevant).	Estuary Foreshores	DPI (Crown Lands Division)	GCC	**Implemented and Ongoing**	MORE ASSISTANCE REQUIRED FROM COMPLIANCE TO ADDRESS SIGNIFICANT ENCROACHMENT ISSUE ACCROSS THE SOUTHERN HALF OF CC LGA Commenced and ongoing. Mandatory stage inspections occur for Council certified/approved works to ensure development is aligned to conditions of consent. For WQ sediment and erosion controls monitored and ensure roof water connected. External complaints where development has been externally certified are responded to by Council on receipt of complaint.

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
C15	Information, Communications and Education	Enforce littering restrictions and undertake parallel education programs about littering.	LGA-wide	GCC		**Implemented and Ongoing**	Council continues to work closely with Clean4Shore to remove litter from the estuary. This program also aims to educate the general public about the extent and impact of marine debris in the local area. 2017/18 - Council to facilitate a workshop with Take3 to educate primary school children about the impacts of marine debris on estuarine ecosystems.
E01	Habitat and Species Conservation	Distribute NSW Maritime's Brisbane Water Boating Map to ensure waterway users are aware of the regulations relating to navigational safety, permissable activities and their responsibilities as boat users.	Registered Boat Owners	NSW Maritime		**Completed**	Map available online or via RMS Offices
E02	Information, Communications and Education	Label stormwater drain inlets in problematic areas "This drains to ……".	Catchment-wide	GCC		**Unknown**	Theme for 2016 School Environment Program is The Drain is Just for Rain, stencils will be provided to schools for labelling school drains with this logo
E03	Information, Communications and Education	Develop a public awareness and education program relating to the Estuary and its biodiversity. Elements for inclusion in this program may include: - Key habitat types and their ecological function (e.g. saltmarshes, seagrasses), - Biodiversity and threatened and protected species (e.g. migratory birds), - Marine pests and other threats to estuarine ecology, and - The important underlying ecological processes of the Estuary and their relationship with human uses of the Estuary. This program may include different educational elements such as targeted activities, information days, the preparation of literature and/or interpretive signage.	LGA-wide	GCC	CMA	**Implemented and Ongoing**	2017/18 - Council has applied for $100,000 via the NSW Environmental Trust to develop an estuary education program for Broisbane Water. 2017/18 - Council to facilitate a workshop with Take3 to educate primary school children about the impacts of marine debris on estuarine ecosystems. 2019/20 - Council commenced implementation of an education program targeting sediment management at building sites. Funding via the NSW Environmental Trust.
E07	Information, Communications and Education	Establish a 'Clean Up Brisbane Water Day' with the dual objectives of removing rubbish from the Estuary foreshores and waterways, and of educating the public about the Estuary.	Waterway-wide	GCC	CMA, NSW Maritime, OEH	**Implemented and Ongoing**	Council provides substantial support to Clean4Shore (a not for profit incorporated organisation) to undertake clean-up activities throughout Brisbane Water. On-going.
E08	Information, Communications and Education	Give consideration to methods of detecting and informing the community of changes to sea levels and other potential climate change impacts. These methods should not result in a sense of panic or alarm, instead they should empower the community to act in a well considered and informed manner and where possible, encourage the community to become engaged in Council's decision making processes. The information provided to the public should be supported by research presented by the IPCC and the State/Federal government, as well as observed trends in local sea levels.	LGA-wide	GCC	OEH, CMA	**Implemented and Ongoing**	Commenced and ongoing. Council has developed a climate change awareness raising campaign to include education on adaptation. Information has been provided to community via webpage and factsheets as well as in engagement activities for major planning projects.

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
E09	Information, Communications and Education	Provide foreshore property owners with information/guidelines about what constitutes good and bad practice with respect to foreshore management (e.g. limits of mowing, stabilisation works, etc.). This should include information on environmentally friendly seawall options to both the community and those individuals assessing development applications for these structures. Reference should be made to DECC's Environmentally Friendly Seawalls: A Guide to Improving the Environmental Value of Seawalls and Seawall-lined Foreshores in Estuaries (2009).	Foreshore Property Owners	GCC	OEH	**Not Commenced / Outstanding**	
E11	Information, Communications and Education	Conduct an education program for the boating community on: - Their responsibilities with respect to the disposal of ballast, sewage and rubbish, - The location of existing sewage pump-out and rubbish disposal facilities, and - How to safeguard against leaks and spills, and what to do if a leak or spill occurs. This should include a distribution of a copy of NSW Maritime's Don't Make Waves (2006) brochure.	LGA-wide	NSW Maritime	CMA	**Implemented and Ongoing**	Commenced and ongoing.
E14	Habitat and Species Conservation	Distribute I&I NSW's NSW Recreational Saltwater Fishing Guide 2011 (2010), which provide advice about fishing regulations, responsible fishing and safety tips.	Boat Owners Fishing Licence Holders	DPI (Fisheries)	Fishcare Volunteers	**Implemented and Ongoing**	Commenced and Ongoing. Latest vesion of Guidelines provided to rec fishers, fishing groups, field days and online.
E15	Information, Communications and Education	Provide for improved communication of on the ground works implemented under the Estuary Management Plan.	All	GCC		**Implemented and Ongoing**	2018/19 - Council commenced consultation on Climate Change Policy. Further advice required from Environmental Strategies section.
E16	Information, Communications and Education	Provide opportunity for community members to become involved in the implementation of on the ground works (where possible).	All	GCC	CMA	**Implemented and Ongoing**	Commenced and ongoing including Clean4Shore, Green Army, Bushcare, CEN Waterwatch programs.
E17	Information, Communications and Education	Enhance the understanding of Council staff on the potential impacts of maintenance activities on the ecological values of the Estuary.	All	GCC		**Implemented and Ongoing**	Commenced and ongoing. Erosion and sediment control training undertaken in 2014. Part 5 environmental assessment training to be rolled out in 2016. 2018/9 - Additional training targeting local construction companies commenced.
E18	Information, Communications and Education	Undertake a stormwater education program highlighting impacts of human activities on ecological values.	All	GCC	CCCEN	**Implemented and Ongoing**	Storm water education programs implemented within existing preschool and school programs. Results of the Beachwatch program are communicated the the community weekly during the swimming season (September to April)
P01	Water and Sediment Quality	Provide for the development, implementation and regular re-assessment of Riparian Zone and Bank Management Plans for the major tributaries draining into the Estuary, including Narara Creek River care Plan, Erina Rivercare Plan, Kincumber Creek Riparian Plan, Woy Woy Creek, Currumbine Creek and Ettalong Creek.	Catchment-wide	GCC	NOW	**Implemented and Ongoing**	Commenced and ongoing. A Project was undertaken in 2009/10 with landowners on the upper reaches of Erina Creek. Substantial work has also been undertaken on Ettalong Creek, Corrumbine Creek works were commenced in 2010 and are on-going. Tascott Creek works were commenced in 2010 and are on-going. Floating landcare project was undertaken in 2014/15 on Narara Creek.

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
P02	Water and Sediment Quality	Develop and implement a pollution response strategy to address major pollution events. Policy D1.02 - Oil Spillages in Navigable Waters should be updated accordingly.	Waterway-wide	GCC	OEH, NSW Maritime	**Not Commenced / Outstanding**	Policy no longer registered with Council. State arrangements are outlined in the NSW State Plan and the guidelines were created to support the State Plan regarding smaller scale incidents within State waters. In addition there is a MOU between FRNSW, PANSW and RMS regarding marine pollution. RMS work in strengthening our capability and relationships with FRNSW to ensure the Inland waters (including estuaries and rivers) are appropriately prepared to respond to an incident. There is a large amount of training being undertaken by the Marine Pollution Unit at Transport for NSW across agencies with responsibilities in NSW.
P03	Water and Sediment Quality	Support State government proposal to prohibit 2 stroke outboard motors.	Waterway-wide	NSW Maritime	GCC	**In progress / Incomplete**	Input from NSW Maritime directed status query to Transport NSW (formerly Maritime Management Centre)
P04	Water and Sediment Quality	Review the Water Cycle Management Guidelines (2007) and ensure that they reflect best practice WSUD and appropriately support the new DCP.	LGA-wide	GCC		**Not Commenced / Outstanding**	
P05	Water and Sediment Quality	Investigate the need for sediment traps and other stormwater management measures to control any erosion and sedimentation from sloping lands draining to the stormwater outlet opposite Byalla Lane.	Saratoga	GCC		**Not Commenced / Outstanding**	Inspection to be undertaken 04/04/2016. Location not considered a high priority when considering catchment-wide pressures and hotspots. An estuary wide Water Quality Improvement Plan is required which would be informed by existing information and detailed audits of each sub-catchment.
P07	Sedimentary Processes	Develop formal standard designs for key navigational channels in Brisbane Water that identify the desired channel profile and likely maintenance dredging requirements to maintain these configurations for the purposes of recreational and commercial boating. The purpose of this action is to provide clear information to users of Brisbane Water and manage community expectations in relation to maintenance of navigation channels, while acknowledging natural rates of sediment transport in these locations and likely environmental impacts. This process should be informed by the Sediment Management Plan provided in the Brisbane Water Estuary Management Study (Cardno, 2010) and the findings of the Brisbane Water Estuary Processes Study (Cardno, 2008). It is acknowledged that additional investigations may be required to develop the standard designs.	Waterway-wide	NSW Maritime, DPI (Crown Lands Division)		**Implemented and Ongoing**	No formal approach adopted. A mix of approaches are applied to provide clear information to users of Brisbane Water and manage community expectations in relation to maintenance of navigation channels, while acknowledging natural rates of sediment transport in these locations and likely environmental impacts.
P08	Sedimentary Processes	Review and revise DCP 145 Boating Facilities in St Huberts Island Canals to ensure consistency with the goals and objectives of the Estuary Management Study and Plan. In particular, explicit consideration of sedimentary processes should form part of the assessment process for all development applications.	St Huberts Island	GCC		**Implemented and Ongoing**	Plan of Management for the St Huberts Island Canals is in preparation. PoM due to be finished 17/18. Works to be implemented as required. Most works identified in the PoM are likey to be undertaken by private landowners via the DA process.

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
P09	Sedimentary Processes	Implement tighter erosion and sedimentation controls to minimise risks to seagrass, with a priority for catchments adjacent to areas of seagrass of high value for species.	Catchment-wide	GCC	DPI (Fisheries)	**Implemented and Ongoing**	Commenced and ongoing. Mandatory stage inspections occur for Council certified/approved works to ensure development is aligned to conditions of consent. For WQ sediment and erosion controls monitored and ensure roof water connected. External complaints where development has been externally certified are responded to by Council on receipt of complaint.
P14	Sedimentary Processes	Continue to enforce prohibition of mowing to the waters edge in both public and private foreshore areas in order to minimise foreshore erosion and impacts on estuarine vegetation and Endangered Ecological Communities.	Estuary-wide	GCC		**Implemented and Ongoing**	Commenced and ongoing. 21012/13 - No mow zone established at Romford Close Davistown and Kylie Close Bensville.
P16	Habitat and Species Conservation	Investigate opportunities to purchase saltmarsh areas for incorporation into Council's reserve system in accordance with Policy R0.15 - Acquisition of Wetlands.	Estuary Foreshores	GCC	DPI (Crown Lands Division)	**Implemented and Ongoing**	Policy amended to form part of Councils Wetland Management Policy. This includes the following relevent sections: 5.1 Council will investigate options for protecting or acquiring wetlands on private land. 5.2 Where possible Council will acquire wetlands in accordance with a priority program. Acquisition of wetlands would be in accordance with policy A5.02 Land and Property Transactions.
P19	Habitat and Species Conservation	Develop a strategy for the conservation of areas important for the biodiversity of invertebrates. Particular attention should be paid to priority sites that represent the greatest proportion of species, including Ettalong, Narara Creek, Koolewong, and Woy Woy Bay-Pelican Island.	Ettalong, Narara Creek, Koolewong, and Woy Woy Bay-Pelican Island	GCC	DPI (Fisheries), OEH, University of Newcastle	**In progress / Incomplete**	Council continues to liaise with UoN and other research organisation regarding potential research partnerships
P20	Habitat and Species Conservation	Develop a conservation and education strategy for seagrass beds, as identified in the Estuary Processes Study (Cardno, 2008), that: - Support the highest abundance and diversity of fish, - Are known to be important for sponges and ascidians, and - Are known to be important for biological connectivity.	Estuary-wide	DPI (Fisheries)	GCC, University of Newcastle, Fishcare Volunteers	**Implemented and Ongoing**	Commenced and underway. General information on seagrass habitats, threats and protective measures provided by NSW Fisheries state-wide. Key habitats identified and understood. 2014/15 - Council provided in-kind support to the estuary 'Project Aware' facilitated by the Ocean Care and Coastal Initiative (OCCI). Support included wetland presentation and field trip at Bensville. 2017/18 - Council has applied for $100,000 via the NSW Environmental Trust to develop an estuary education program for Broisbane Water. 2017/18 - Council to facilitate a workshop with Take3 to educate primary school children about the impacts of marine debris on estuarine ecosystems.
P23	Habitat and Species Conservation	Develop a conservation strategy for the birds of Brisbane Water Estuary that addresses the main issues of disturbance by pedestrians, dog-walkers and watercraft, predation by feral and domestic animals, and habitat loss/degradation. This should include consideration of threatened and protected species, such as the Bush Stone Curlew, and the habitats that support them.	Waterway-wide / Catchment-wide	GCC	CMA, OEH, local bird watching clubs	**Not Commenced / Outstanding**	Not commenced
P27	Habitat and Species Conservation	Develop a Plan of Management to provide protection for the Bush Stone Curlew populations occurring around the Estuary. In addition, provide for ongoing implementation of the Plan of Management for Green and Golden Bell Frogs.	LGA-wide	GCC	OEH, University of Newcastle	**In progress / Incomplete**	Council in preliminary discussions with University of Newcastle concerning knowledge gaps relating the GGBF populations on the Central Coast.

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
P28	Habitat and Species Conservation	Provide adequate resources within Council to provide for ongoing management of Bushcare volunteers.	LGA-wide	GCC		**Implemented and Ongoing**	Commenced and ongoing. There are currently 34 groups functioning LGA-wide with 2 expressions of interest, 2 additional groups in discussion. Locations being worked on within the Brisbane Water Catchment include Blackwall Mountain, Burrawang, Bushlands Avenue, Cappers Gully, Goodaywang Reserve, Green Point (3 groups), Kariong Eco Gardens, Katandra Reserve, Kincumber (3 groups), Matcham, Narara Creek, Niagara Park Pioneer Park, Rumbalara and Lisarow High School. 4shore clean-up and Floating landcare also operates across the estuary.
P30	Habitat and Species Conservation	Develop a DCP for Wetlands aimed at maintaining and restoring natural biological and physical processes of wetland function by minimising changes to wetland hydrology from land uses in the catchment. This should be undertaken in line with DECCW's NSW Wetlands Policy (2010b).	LGA-wide	GCC		**Implemented and Ongoing**	Commenced. Map layer completed in partnership with the University of Newcastle.
P31	Cultural Heritage	Provide ongoing protection for sites of Indigenous and non-Indigenous heritage significance for the local community.	LGA-wide	OEH, DP&I	GCC	**In progress / Incomplete**	Commenced and ongoing. Site by site basis at this stage, requires coordinated and strategic approach.
P33	Recreational Usage	Provide linkages between different portions of publicly accessible foreshores by linking with other foot or cycle paths and public transport linkages in line with Council's Cycleway Strategy.	Catchment-wide	GCC		**Implemented and Ongoing**	Commenced and ongoing. Including Kincumber Broadwater cycleway, Magnolia Avenue Davistown and implementation of Ettalong PoM. INPUT FROM CONSTRUCTION PLANNING AND MANAGEMENT REQUIRED FOR EXPENDITURE
P35	Recreational Usage	Finalise Council's Dinghy Storage Policy and progress through implementation of the Foreshore Reserves Dinghy Storage Implementation Plan.	Estuary Foreshores	GCC	NSW Maritime	**Implemented and Ongoing**	Commenced and underway. Draft Policy and Plan developed. Provision of dinghy storage facilities has occurred at various locations, with part funding via the NSW Government Better Boating Program (BPP).
P39	Recreational Usage	Assess options for relocation of the Pretty Beach pool such that it will be suitable for swimming under all tidal conditions and is not subject to sediment build-up.	Pretty Beach	GCC		**Not Commenced / Outstanding**	Not commenced
P40	Recreational Usage	Consider the need to develop a Wrack Management Policy that clearly identifies: - The regulatory requirements that must be addressed in order to remove seagrass wrack from foreshore areas, - The manner in which this should be undertaken, and - Suitable secondary uses for wrack.	Estuary Foreshores	GCC		**In progress / Incomplete**	Council has a fisheries licence covering removal of wrack from open coast beaches and various locations around Brisbane Water. Not a high priority issue for Brisbane Water
P41	Recreational Usage	Prepare a Brisbane Water Estuary Users Plan which addresses such issues as equity of access, boat storage, conflicts of usage, mooring types and caps, number and type of public access points (wharves and jetties), coverage and consistency of foreshore Plans of Management with priority areas identified for new Plans of Management, estimation of an estuary carrying capacity with respect to development intensity, fishing/fisheries and boating. Reference should be made to the Brisbane Water Estuary Processes Study (Cardno, 2008), particularly Appendix N, for further details on existing recreational patterns, conflicts and future opportunities, as well as details of where recreation may be impacting on other estuarine processes (e.g. on ecological processes). It is noted that implementation of this action is also dependent upon the provision of supporting information via the implementation of other management actions (as indicated).	Estuary Foreshores / Waterway-wide	GCC		**Completed**	Completed. Brisbane Water Public Boat Ramp and Wharf User Study adopted by Council on 17 September 2013. Currently being imlemented to prioritise expenditure for facility improvements.

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
P43	Foreshore Development	Prepare a Climate Change Adaptation Plan that will deliver land use zoning and development controls for the Estuary that are based on the current IPCC projections of 0.9m sea level rise by 2100. The preparation of this study should be closely linked to the Brisbane Water Foreshore Coastal Floodplain Risk Inundation Management Study and Plan, anticipated to be drafted by 2011.	Estuary Foreshores	GCC	OEH	**Implemented and Ongoing**	Climate Change Adaptation Planning ongoing. Action PM09 in BWFRMP concurs with need for this action. Development controls have been developed across estuary and are being implemented. 2018/19 - Council's Environmental Strategies section commenced development of a climate change policy to cover the entire LGA.
P44	Foreshore Development	Develop a guiding policy regarding the water boundary determination for foreshore properties consistent with Clause 55N of the Coastal Protection Act 1979.	Estuary Foreshores	DPI (Crown Lands Division)	GCC	**Not Commenced / Outstanding**	
P45	Foreshore Development	Undertake a review of the existing foreshore development policies and plans for the Gosford LGA and assess the need to amend development controls to provide for controlled, sustainable development of the foreshore.	LGA-wide	GCC		**Not Commenced / Outstanding**	Not commenced
P46	Foreshore Development	Review existing DCP 119 - Wharves and Jetties with a view to ensuring the policy is in accordance with the goals and objectives of the Estuary Management Study and Plan. In addition, sea level rise projections should also be considered where facilities are to be upgraded.	LGA-wide	GCC	DPI (Crown Lands)	**Completed**	Forms part of new DCP Section 3.16 Water Recreation Structures. Section 3.16.3 details Objects of the DCP Chapter and includes Clause h: ensure that development has regard for and does not adversely affect important estuarine flora including seagrasses, mangroves and saltmarshes or fauna habitats and fishing grounds which may be in proximity to the proposed development
P47	Foreshore Development	Encourage jetty sharing arrangements via the leasing mechanism such that each jetty services 2-3 properties. This will involve review of applications for new leases as well as license/lease renewals.	Waterway-wide	DPI (Crown Lands Division)		**Implemented and Ongoing**	NSW Dept Primary Industries (Lands) Domestic waterfront facility policy 2014 is implemented on an ongoing basis. It includes the Key Policy Objective (Section 2.1d) Shared domestic waterfront facilities are encouraged where it is appropriate or necessary to minimise the number of structures on Crown land and reduce cumulative impact. Parties subject to sharing arrangements receive separate licence agreements based on the area of occupation
P48	Foreshore Development	Develop environmentally friendly design and construction guidelines for foreshore infrastructure such as jetties, boat ramps, seawalls/retaining walls and foreshore protection works. This should include advice on retro-fitting existing structures to be more environmentally friendly. The guidelines should be made publicly available and distributed to all foreshore property owners. (Note: Seawalls addressed in DECC's Environmentally Friendly Seawalls guidelines (2009)).	LGA-wide	GCC	NSW Maritime, OEH, DPI (Fisheries)	**Not Commenced / Outstanding**	Environmentally friendly design considerations are incoporated into all seawalls planned for public land. DPI Fisheries required mesh-style decking on new jetties to enable light penetration to facilitate sea grass growth. The guidelines for the management of the St Huberts Island Canals incorporate consideration of environmentally friendly design features.
P49	Foreshore Development	Develop guidelines (or compile existing guidelines where available) for foreshore stabilisation via the establishment of locally native estuarine plant species. The guidelines should provide details of the benefits of soft stabilisation works, advice on the species to be used and how to establish plantings. Seedlings may be cultivated at Council's nursery for supply to interested parties.	LGA-wide	GCC	CMA, OEH	**Implemented and Ongoing**	Soft engineering approaches are implemented in preference to hard engineering where possible.
P50	Foreshore Development	Review D6.47 - Setback Policy: Creeks, Rivers and Lagoons. The review should in the first instance widen the definition of applicable waterbodies to incorporate 'estuaries', and in the second instance be re-assessed to incorporate the likely impacts of climate change. In particular, the setbacks applied should be re-assessed to take into account processes relating to both catchment flooding and foreshore inundation.	LGA-wide	GCC		**Unknown**	Policy has not been extended to estuaries specifically but applies to Creeks.

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ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
P53	Commercial Development	Promote the Brisbane Water Estuary for eco-tourism and support relevant local commercial development in this area.	Estuary Foreshores / Waterway-wide	GCC	DPI (Crown Lands Division), Central Coast Tourism, Gosford Chamber of Commerce	**Implemented and Ongoing**	Central Coast Tourisms "Central Coast Destination Management Plan for the Visitor Economy 2013 to 2017" includes the strategic priority to Develop an investment prospectus for ecotourism opportunities including accommodation and attractions. A range of potential projects are being pursued as identified in the Central Coast Tourism Opportunity Plan 2013. REQUIRE ADVICE IN RELATION TO WHO WON THE CONTRACT TO PROMOTE TOURISM ON THE CENTRAL COAST. A MEETING WITH THE SUCCESSFUL PROVIDER SHOULD BE FACILITATED.
P54	Commercial Development	Promote the sustainable commercial development of the Estuary and its foreshores in accordance with Council's Corporate Strategy, Gosford City Centre Masterplan and the principles of Ecologically Sustainable Development.	Catchment-wide / Waterway-wide	GCC	DPI (Crown Lands Division)	**Implemented and Ongoing**	Commenced and ongoing.
P55	Commercial Development	Investigate options for constructing new (and/or expanding existing) boating facilities.	Waterway-wide	DPI (Crown Lands Division), Private Developers	GCC	**Implemented and Ongoing**	Completed. Brisbane Water Public Boat Ramp and Wharf User Study adopted by Council on 17 September 2013. Currently being implemented to prioritise expenditure for facility improvements.
P56	Commercial Development	Develop a strategy to promote and enhance the connection between the Gosford city centre and the Brisbane Water Estuary.	Gosford	GCC	DP&I	**Implemented and Ongoing**	Commenced and ongoing. NSW department of planning has developed a strategy to reviatlise Gosford City Centre: https://www.planning.nsw.gov.au/News/2018/Gosford-City-Centre-Revitalisation-Fact-Sheet
P56	Commercial Development	Use the findings of the Estuary Processes Study (Cardno, 2008) to inform the masterplanning process for the Gosford city centre.	Gosford	GCC	DP&I	**In progress / Incomplete**	Commenced and ongoing. https://www.planning.nsw.gov.au/News/2018/Gosford-City-Centre-Revitalisation-Fact-Sheet
P59	Governance	Adopt the Vision Statement for the Brisbane Water Estuary provided in the Estuary Management Plan.	Catchment-wide / Waterway-wide	GCC		**Completed**	Vision statement was effectively endorsed and adopted when Council formally adopted the BWCZMP in July 2012.
P60	Information, Communications and Education	Ensure that climate change considerations are incorporated into all relevant Plans of Management for locations around the Estuary.	LGA-wide	GCC	OEH, CMA	**Implemented and Ongoing**	Climate adaptation (& mitigation) considered in strategic planning processes internally. Interview undertaken for all business units in 20. Staff survey complete. Desktop analysis complete. Information needs to be compiled into a report for managers and SMG and a further report for our insurer with the assistance of Mike Tattoli. Since this is a proactive project, there is no set deadline
R01	**Water and Sediment Quality**	**Conduct a review of the design and methodology employed in the existing water quality monitoring program. Ideally the program should be a comprehensive, scientifically rigorous and ongoing program of water and sediment quality monitoring for the Brisbane Water Estuary, incorporating dry weather and event monitoring of both the tributary mouths and main waterbody. Sampling in the main waterbodies should incorporate vertical profiling.**	**Catchment-wide / Waterway-wide**	**GCC**	**OEH**	**Not Commenced / Outstanding**	W&CP have had discussions with OEH concerning monitoring of water quality in all the Central Coast Estuaries.

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ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
R03	Water and Sediment Quality	Calculate a nutrient budget for the Estuary to assess the potential for eutrophication of the more enclosed portions of the waterway. The analysis should assess current conditions and conditions under climate change scenarios. Reference should be made to the water quality modelling undertaken for the Estuary as a whole, as outlined in Appendix E of the Estuary Processes Study (Cardno, 2008).	Waterway-wide	OEH	GCC	**Not Commenced / Outstanding**	
R04	Water and Sediment Quality	Audit the performance of existing stormwater quality improvement devices and assess the need for modifications.	Catchment-wide	GCC		**Not Commenced / Outstanding**	An estuary wide Water Quality Improvement Plan is required which would be informed by existing information and detailed audits of each sub-catchment. HIGH PRIORITY ACTION
R05	Water and Sediment Quality	Keep a log of the volumes and types of material removed from GPTs during routine maintenance and incorporate this information into the water quality monitoring program.	Catchment-wide	GCC		**Not Commenced / Outstanding**	
R06	Water and Sediment Quality	Undertake ongoing monitoring and maintenance of Council owned stormwater quality improvement devices.	Catchment-wide	GCC		**Implemented and Ongoing**	An estuary wide Water Quality Improvement Plan is required which would be informed by existing information and detailed audits of each sub-catchment. HIGH PRIORITY ACTION
R09	Sedimentary Processes	Conduct ongoing monitoring (by survey) of key navigation channels, including: - Entrance Channel, - Paddy's Channel, - Lintern Channel, - Woy Woy Channel, - Wagstaffe Channel, - Cockle Channel, and - Saratoga Channel.	Waterway-wide	NSW Maritime		**Implemented and Ongoing**	Commenced and ongoing.
R10	**Sedimentary Processes**	**Conduct a condition assessment of existing stormwater outlets draining into the Estuary focusing on assessing impacts on natural sedimentary processes (e.g. erosion, accretion) and adjacent habitats.**	**All foreshore areas**	**GCC**		**Not Commenced / Outstanding**	An estuary wide Water Quality Improvement Plan is required which would be informed by existing information and detailed audits of each sub-catchment. HIGH PRIORITY ACTION
R11	Sedimentary Processes	Investigate sedimentary processes to determine appropriate long term management strategies to maintain property protection and public access along the foreshore between Ferry Road, Ettalong and the eastern most point of Booker Bay foreshore.	Ettalong Beach	GCC	DPI (Crown Lands Division)	**Implemented and Ongoing**	A sediment transport study was completed as part of the development of a beach nourishment program for Ettalong Beach in 2011/12 with 50% funding from the OEH Estuary Management Program. The beach was subsequently nourished in 2012 with sand won from the Ettalong Shoal. Beach nourishment is considered to be an on-going management activity for Ettalong Beach to 1. maintain beach amenity, 2. provide a storm buffer to protect the seawall and landward infrastructure, and 3. protect heritage items buried on the beach.
R14	Sedimentary Processes	Investigate options for upgrading the seawall along Masons Parade and Dane Drive, Gosford, in line with the Gosford Challenge/City Centre Redevelopment to consider environmentally friendly design.	Gosford	GCC		**Not Commenced / Outstanding**	Commenced and ongoing. NSW department of planning has developed a strategy to reviatlise Gosford City Centre: https://www.planning.nsw.gov.au/News/2018/Gosford-City-Centre-Revitalisation-Fact-Sheet
R15	Sedimentary Processes	Investigate options for addressing/managing subsidence currently occurring near Erina Creek.	Muloora Rd, Springfield	GCC		**Completed**	Site visit conducted in 2013 and subsidence undetected.

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ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
R16	Sedimentary Processes	Identify the cause of erosion under the bridge near Lara Street and outline measures to address this issue.	Park Bay	GCC		**Completed**	Site visit conducted in 2013 and erosion undetected.
R17	Sedimentary Processes	Investigate options for implementation to address the erosion of the seawall on the sourthern shore of Hardys Bay.	Killcare	GCC		**Not Commenced / Outstanding**	Foreshore assessed as part of estuary-wide prioritisation matrix.
R18	Habitat and Species Conservation	Conduct a survey of recreational fishing catches and analyse recreational fishing trends to characterise both the impact on the fish populations of Brisbane Water Estuary and the value of recreational fishing as a local industry.	Waterway-wide	GCC	University of Newcastle, Fishcare Volunteers / DPI (Fisheries)	**Not Commenced / Outstanding**	Resonsibility for this action should rest primarily with DPI Fisheries.
R19	Habitat and Species Conservation	Investigate options for the landward migration of intertidal habitats such as saltmarsh under climate change scenarios.	Estuary Foreshores	GCC	CMA, OEH	**Implemented and Ongoing**	This formed part of the initial prioritisation for works in wetlands. Works were commenced at Kylie Close Wetlands at Bensville due to the potential for migration on this site.
R20	Habitat and Species Conservation	Investigate opportunities to monitor indicator organisms within the Estuary to assess effectiveness of management measures to protect biodiversity and maintain the ecological health of the Estuary.	Waterway-wide / Catchment-wide	DPI (Fisheries), GCC	CMA, OEH	**Implemented and Ongoing**	Council working collaboratively with OEH on an MER program for the estuary.
R22	Habitat and Species Conservation	Monitor the extent of riparian, foreshore and aquatic vegetation around the Brisbane Water Estuary. Trends in vegetation condition and extent should be reported every five years. Reference should be made to the NSW Government's NSW Monitoring, Evaluation and Reporting Strategy for estuaries to assess extent of mangrove, saltmarsh and seagrass (the latter to species).	Waterway-wide / Catchment-wide	DPI (Fisheries)	CMA, OEH	**Not Commenced / Outstanding**	
R24	Habitat and Species Conservation	Investigate the use of constructed wetlands, sediment, and detention basins and other WSUD options to minimise the effect of freshwater and sediment inflows, with particular reference to areas of high biodiversity value around entrances to creeks. Consideration should be given to both current and future meteorological conditions.	Catchment-wide	GCC	CMA	**Not Commenced / Outstanding**	An estuary wide Water Quality Improvement Plan is required which would be informed by existing information and detailed audits of each sub-catchment. HIGH PRIORITY ACTION
R25	Habitat and Species Conservation	Manage Caulerpa taxifolia in accordance with I&I NSW's NSW Control Plan for the Noxious Marine Alga Caulerpa taxifolia (2009).	Waterway-wide	DPI (Fisheries)		**Implemented and Ongoing**	Ongoing management of species undertaken by Fisheries. Education and response to sightings. Risk of widespread invasion better understood following research and managed.
R26	Habitat and Species Conservation	Develop a research partnership with universities to continue the scientific focus on Brisbane Water Estuary and support this with annual research grants.	LGA-wide	GCC	Universities	**Implemented and Ongoing**	Ecoresearch Grant program discontinued in 2014. Council staff continue to identify partnership opportunities as they arise. Ongoing discussions with the University of Newcastle to identify research collaborations.
R27	Cultural Heritage	Identify the likely location and condition of ship wrecks near the old bar via a maritime archaeological survey.	Entrance	DP&I	DPI (Crown Lands Division)	**Not Commenced / Outstanding**	Input from Rebecca Cardy

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ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
R28	Cultural Heritage	Assess the potential impacts of climate change on heritage items located around the Estuary and along its foreshores.	Waterway-wide / Catchment-wide	DP&I	GCC, OEH, DLALC	**In progress / Incomplete**	A key recommendation (PM9) of the BWFRMP. The projected impacts of sea level rise on the following assets could be incorporated into the investigations: • Heritage items and places – Investigate the impacts of future flooding and emergency response arrangements on heritage buildings, structures, items and places This should include a field survey of historic infrastructure and archaeological items and review of known heritage database records for both Aboriginal and non-Aboriginal heritage. Recommendations for the mitigation of negative impacts on heritage items should also be formulated.
R29	Cultural Heritage	Recognise the historic Aboriginal ownership and use of the area by undertaking research into local languages, customs and significant sites.	LGA-wide	GCC	OEH, DLALC	**In progress / Incomplete**	Input from Rebecca Cardy - W & CP has an on-going dialog with relevant Aboriginal groups concerning upcoming foreshore works. Council liaising with Guringai Tribal Link in relation to a large midden identified on Rip Road Reserve, Blackwall. A project commenced (Feb 2019) to develop a design for a revetment in this location to address erosion AND protect the midden.
R31	Recreational Usage	Conduct an audit of existing land-based and water-based infrastructure for boating (e.g. picnic tables, playgrounds, BBQs, jetties, boat ramps, dinghy storage areas, moorings, trailer parking areas, car parking, garbage bins, toilets, shared pathways, etc.) focusing on: - Patterns in patronage/usage, - Condition and maintenance requirements, - Characterisation of neighbouring land uses, - Proximity to key habitat, heritage items and other environmentally sensitive areas, - Proximity to key locations (e.g. pump out stations, marinas, popular fishing spots, etc.), and - Safety. Based on the outcome of the audit, assess the need to upgrade, maintain or de-commission existing infrastructure. The purpose of this audit is primarily to rationalise recreational access and amenity. The findings may be used to inform Action P41, the Users Plan.	Estuary Foreshores / Waterway-wide	GCC	DPI (Crown Lands Division), NSW Maritime	**Completed**	Completed. Brisbane Water Public Boat Ramp and Wharf User Study adopted by Council on 17 September 2013. Currently being imlemented to prioritise expenditure for facility improvements.
R35	Recreational Usage	Investigate options for providing safe public access over/under the rail line to the foreshore adjacent to Railway Street.	Woy Woy	GCC	RailCorp	**Completed**	Design completed to raise Woy Woy Road above flood level No funding identified to undertake works.
R36	Governance	Establish an annual reporting mechanism to communicate progress towards achieving the goals and objectives of the Estuary Management Plan and Estuary Monitoring Plan. The annual report should consider the need for adaptive management as required.	Catchment-wide / Waterway-wide	GCC		**Not Commenced / Outstanding**	HIGH PRIORITY ACTION
R37	Governance	Design a comprehensive Estuary Monitoring Plan to include elements of the physical, social and biological environment to evaluate the success in meeting the objectives and goals outlined in the Estuary Management Plan. The Monitoring Plan should draw together all those individual monitoring activities listed in the actions list into a single overarching framework in line with the NSW Government's NSW Monitoring, Evaluation and Reporting Strategy. The Plan should include reporting on compliance matters, in addition to more general estuary health monitoring activities.	Catchment-wide / Waterway-wide	GCC		**Implemented and Ongoing**	Underway as part of Gosford Coastal Management Program Strategc Review

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ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
R38	Governance	Research possible sources of funding and secure ongoing funding for implementation of the Estuary Management Plan. It is anticipated that responsibility and funding for these studies/plans may be shared across State, Federal and local government agencies.	Catchment-wide / Waterway-wide	GCC		**Implemented and Ongoing**	Ongoing.
R39	Information, Communications and Education	Develop and maintain a database of all environmental and ecological data available for the Brisbane Water Estuary with a view to providing a comparison between present and historic Estuary conditions. This database should be regularly updated with the results of any monitoring undertaken. Long term trends should be identified and this information communicated directly to the public on a regular basis.	Catchment-wide / Waterway-wide	GCC	CMA, OEH	**Not Commenced / Outstanding**	HIGH PRIORITY ACTION
R40	Information, Communications and Education	Provide for ongoing monitoring of estuarine water levels to provide a continuous long term data set. This is key for monitoring the potential impacts of climate change and initiating appropriate adaptive management responses. The need to install additional water level gauges should be considered.	Waterway-wide	OEH		**Implemented and Ongoing**	Commenced and ongoing. Monitoring of local water levels ongoing. More detailed analyses undertaken via long term tide gauges. A key recommendation (PM9) of the BWFRMP is that Climate Change Adaptation Plans are prepared to ensure an integrated approach to dealing with the risks associated with climate change.
R41	Information, Communications and Education	Develop a policy or guideline document detailing specific trigger levels for implementing an adaptive management response to observed climate change impacts on key estuary processes. The trigger levels should be based on observations arising from the Estuary Monitoring Plan (R37) and should (where possible) be explicitly defined. A corresponding adaptive management response should be developed for each trigger. The policy should be reviewed as climate change projections are updated or as additional data/information becomes available.	Waterway-wide	GCC	OEH, DPI	**In progress / Incomplete**	A key recommendation (PM9) of the BWFRMP. The projected impacts of sea level rise on the following assets could be incorporated into the investigations: • Residential areas, both existing and proposed and the long term viability of these areas for development both with and without adaptation strategies. • Public infrastructure – investigate the long term viability of the infrastructure servicing potentially affected areas. • Heritage items and places – Investigate the impacts of future flooding and emergency response arrangements on heritage buildings, structures, items and places • Flora, fauna and other natural resources – Investigate the impacts of projected sea level rise on flora and fauna, with particular emphasis on changes in foreshore vegetation.
R42	Sedimentary Processes	Undertake an estuarine shoreline vulnerability assessment (based on shoreline geomorphology) to assist in planning for sea level rise.	Waterway-wide	GCC	OEH	**Completed**	Vulnerability assessment and mapping undertaken as part of BW Estuary Processes Study. This information has been progressed through establishment of foreshore stabilisation matrix to guide works.
R43	Sedimentary Processes	Undertake a comprehensive geomorphological study of historic and current sedimentation rates at the estuarine outlet areas of the major creeks (Narara, Erina, Kincumber and Woy Woy Creeks).	Waterway-wide	GCC	OEH	**Not Commenced / Outstanding**	An estuary wide Water Quality Improvement Plan is required which would be informed by existing information and detailed audits of each sub-catchment. HIGH PRIORITY ACTION
R44	Water and Sediment Quality	Work with Oyster Growers to develop an Environmental Management Strategy, along with improved water quality monitoring and project collaboration.	Waterway-wide	GCC	Oceanwatch	**Completed**	Complete. The Brisbane Water Oyster Farmers Environmental Management System (EMS) was completed and Launched in November 2014.

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R45	Water and Sediment Quality	To identify primary sources of contamination, especially in the Narara Creek catchment, consider remedial strategies and undertake follow up investigations of sediment in the northern part of the estuary to improve assessment of possible sediment toxicity.	Catchment-wide	GCC		**Not Commenced / Outstanding**	Successful grant awarded under the NSW Estuary Management Project 2012/13. Council unable to match grant $. Grant offer rejected. An estuary wide Water Quality Improvement Plan is required which would be informed by existing information and detailed audits of each sub-catchment. Identification of contaminants would form part of this study, HIGH PRIORITY ACTION
W01	Water and Sediment Quality	Investigate options for implementing catchment based WSUD features in the catchment in order to manage stormwater quality and quantity, with a priority focus on the Narara and Erina Creek catchments, followed by Kincumber Creek catchment.	Catchment-wide	GCC		**Implemented and Ongoing**	An estuary wide Water Quality Improvement Plan is required which would be informed by existing information and detailed audits of each sub-catchment. This plan would help to guide implementation of WSUD infrastructure. HIGH PRIORITY ACTION
W02	Water and Sediment Quality	Install additional sewage pump-out facilities to reduce water pollution. These should be situated at locations accessible by a range of vessels.	Waterway-wide	NSW Maritime		**Implemented and Ongoing**	Sewage pump-out facilities installed at Gosford Sailing Club and Hardys Bay Marina. Usage monitored and locations promoted.
W03	Water and Sediment Quality	Provide for continued implementation of Council's Sewerage Enhancement Program and associated capital investments.	Catchment-wide	GCC		**In progress / Incomplete**	INPUT REQUIRED FROM WATER AND SEWER REGARDING EXPENDITURE
W04	Water and Sediment Quality	Investigate appropriate stormwater treatment and control measures to reduce sedimentation into Correa Bay.	Correa Bay	GCC		**Completed**	Pre dredging studies undertaken for Correa Bay during 2015/16. Study concluded that costs and potential environmental impact outweighed relatively minor benefits of dredging this area. Funding was provided through the Rescuing our Waterways program.
W05	Water and Sediment Quality	Advertise and provide signage for boat pump-out facilities.	Gosford, Hardys Bay	NSW Maritime		**Implemented and Ongoing**	Commenced and ongoing. Public facility at Gosford Sailing Club promoted via boating maps, both it and Hardys Bay verbally.
W06	Water and Sediment Quality	Install and maintain as required sediment traps targeting stormwater flows draining from the escarpment at Hardys Bay.	Hardys Bay	GCC		**Completed**	Mudflat Creek outlet completed 2016 need to monitor silt levels Input from Chris Coombs and/or Mark Smith re mudflat creek Stage I ECM P57 Hardy's Bay to Noble Road channel realignment coat $577,451 Stage 2 ECM 359 Noble Road timber bridge replacement cost $439,378 Stage 3 ECM P429 upstream of noble bridge to deepen and widen open channel to drain existing culvers cost $570,000

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W07	Water and Sediment Quality	Provide ongoing maintenance of existing sediment traps in the catchment draining to Horsfield Bay.	Horsfield Bay Catchment	GCC		**Implemented and Ongoing**	1 Dredge(Noble rd to outlet) lower sediment collection area 76m2 at a depth of 600mm = 45m3 * (bulking factor) 2 = 90 tonne * $190 (dredge levy exemption tip fees) = $17,000.00 Contractor set up and construction and transport charges = $20,000.00 (est based on recent charges in the Everglades Main Drain). Fisheries Licence $360.00 TOTAL $37,360.00 NB at this point it is unclear how often the collector will require clearing. I spoke to Chris Lear and he advised that sediment removal was undertaken 20months ago. Recent inspection by myself indicated the sediment was approaching the removal height.
W09	Water and Sediment Quality	Investigate appropriate WSUD features for those roads that are currently unsealed/unfinished in order to reduce the impact of erosion and sedimentation from these roadways.	Woy Woy, Blackwall	GCC		**Not Commenced / Outstanding**	An estuary wide Water Quality Improvement Plan is required which would be informed by existing information and detailed audits of each sub-catchment. This plan would help to guide implementation of WSUD infrastructure. HIGH PRIORITY ACTION
W10	Water and Sediment Quality	Remediate (or pipe) open drains and install sediment traps for those drains running from Wilkie King and Mundoora Avenues.	Yattalunga	GCC		**Completed**	Mundoora Avenue drain reclaimed as part of Yattalunga Foreshore upgrade
W101	Recreational Usage	Provide improved, safe access for recreational users accessing the foreshore and waterway near Victory Parade, Tascott, via re-configuration of the existing rock wall.	Tascott	GCC		**Not Commenced / Outstanding**	
W104	Recreational Usage	Improve public access along the foreshore reserve between Ironbark Point and Rocky Point. Assess the feasibility of installing a boardwalk, undertaking foreshore stabilisation works and/or creating a public path in front of houses between 36-40 Asca Drive, Green Point.	Green Point	GCC		**Not Commenced / Outstanding**	
W105	Recreational Usage	Extend the Orana Street boat ramp to permit access at low tide.	Green Point	GCC		**Not Commenced / Outstanding**	
W107	Recreational Usage	Provide dedicated parking for users of the boat ramp near Punt Bridge. This would require some initial consideration of feasibility prior to implementation.	Central Coast Hwy	GCC		**Not Commenced / Outstanding**	
W108	Recreational Usage	Undertake review of need requirements for the tidal baths located near Brisbane Water Drive.	Woy Woy	GCC		**Not Commenced / Outstanding**	
W109	Recreational Usage	Investigate and implement suitable options for improving drainage of the oval located near Willaroo Road.	Saratoga	GCC		**Not Commenced / Outstanding**	

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W112	Recreational Usage	Identify measures to improve public access to Lance Webb Reserve and the beach in this location.	Ettalong	GCC		**Completed**	Beach nourishment undertaken in 2012/13 following REF and approvals being sought. Ongoing visual monitoring underway to determine future nourishment regime. Lance Webb Reserve seawall constructed in 15/16.
W114	Sedimentary Processes	Investigate options to improve access to the Volunteer Coastal Patrol sufficient to permit access over the full tidal cycle.	Point Clare	NSW Maritime		**Completed**	Wharf was extended
W115	Sedimentary Processes	Dredge to improve access to the boat pump-out and other facilities in Gosford Harbour. The dredging should be sufficient to permit access over the full tidal cycle.	Gosford Harbour	NSW Government		**Not Commenced / Outstanding**	
W116	Sedimentary Processes	Dredge to improve navigation and access to boat ramps in Cockle Channel.	Davistown	NSW Government		**Not Commenced / Outstanding**	
W117	Sedimentary Processes	Dredge to improve navigation in Woy Woy Channel near Pelican Island.	Woy Woy	NSW Government		**Not Commenced / Outstanding**	
W118	Sedimentary Processes	Dredge to improve navigation in Woy Woy Bay.	Woy Woy Bay	NSW Government		**Not Commenced / Outstanding**	
W120	Sedimentary Processes	Dredge to improve access to the boat pump-out and other facilities in Hardys Bay. The dredging should be sufficient to permit access over the full tidal cycle.	Hardys Bay	NSW Government		**Not Commenced / Outstanding**	
W121	Sedimentary Processes	Investigate options to address access and amenity issues associated with the blockage of the entrance to Riley's Bay and sediment accretion in this area.	Riley's Bay	NSW Government		**Not Commenced / Outstanding**	
W122	Water and Sediment Quality	Investigate the feasibility of increasing the capacity of the culvert under the rail line at Fagans Bay to enhance flushing and thereby improve water quality. This investigation should also consider the influence of any historic sedimentation that may have occurred.	Fagans Bay	GCC		**Not Commenced / Outstanding**	
W123	Habitat and Species Conservation	Investigate the feasibility of utilising artificial reef structures to provide habitat diversity and/or minimise foreshore erosion/recession.	Waterway-wide	GCC	DPI (Fisheries), OEH	**Not Commenced / Outstanding**	Investigating possibility of installing an "Oyster Reef" adjacent to Elfin Hill Road Reserve, Green Point in collaboration with Ocean Watch.
W124	Recreational Usage	Work with the NSW Recreational Fishing Alliance to achieve access and riparian vegetation enhancement to Dell Road Reserve, Narara Creek.	West Gosford	GCC		**Implemented and Ongoing**	A fishing reserve (number 1033748) was established by Crown Land of a section of reserve number 7310. I believe reserve trust is managed by Recreation Fishing Alliance. Crown Lands to verify
W125	Recreational Usage	Provide improved access between foreshore and the waterway for people launching/retrieving small watercraft from Goodaywang Reserve, Point Clare.	Point Clare	GCC		**Completed**	
W14	Water and Sediment Quality	Develop and implement measures to address stormwater quality issues associated with runoff from the access road and fire trails near Fisherman's Parade.	Daleys Point	GCC	OEH	**Not Commenced / Outstanding**	An estuary wide Water Quality Improvement Plan is required which would be informed by existing information and detailed audits of each sub-catchment. This plan would help to guide implementation of WSUD infrastructure. HIGH PRIORITY ACTION
W15	Water and Sediment Quality	Seal the Hawk Street car park to prevent erosion into Kincumber Creek. The use of permeable pavement is recommended over impermeable surfaces.	Kincumber	GCC		**Completed**	Completed in 2014/15 by Council construction crew. Permeable pavement not used due to cost.

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
W16	Water and Sediment Quality	Investigate and implement measures to improve flow/drainage in the open channel near Mundoora Avenue.	Yattalunga	GCC		**Completed**	Mundoora Avenue draing reclaimed as part of Yattalunga Foreshore upgrade
W17	Water and Sediment Quality	Implement a program of maintenance to address the accumulation of litter in the open drain near Beach Street. Long term management of this issue should also be considered, for example, public education and/or the implementation of additional GPTs.	Ettalong	GCC		**Completed**	Baramy Gross polutant trap installed as part of foreshore upgrade works.
W18	Sedimentary Processes	Periodically dredge the navigation channel up to 50,000m3 in the Estuary entrance to ensure safe navigation.	Entrance	NSW Government		**Implemented and Ongoing**	Dredging (and associated approvals) undertaken in 2011. Regular monitoring of chanel undertaken by RMS. Additional dredging undertaken by DPI Crown Lands in 2018 with more to follow 2019. Council currently developing an erosion management strategy for Umina-Ocean Beach which includes investigation of suitable sand sources for beach nourishment. Area of investigation includes the entrance channel to Brisbane Water. NOTE: THIS ACTION WILL BE ONGOING BECAUSE THE ENTRANCE TO BRISBANE WATER CONTAINS A SERIES OF HIGHLY DYNAMIC SAND SHOALS
W19	Sedimentary Processes	Undertake an ongoing program of maintenance to restore the drainage canals of St Huberts Island to their original design criteria.	St Huberts Island	DPI (Crown Lands Division)	GCC	**Implemented and Ongoing**	Plan of Management for the St Huberts Island Canals is in preparation. PoM due to be finished 17/18. Works to be implemented as required. Most works identified in the PoM are likey to be undertaken by private landowners via the DA process.
W20	Sedimentary Processes	Dredge the sand bars in the channel between Blackwall Point and Allfield Road, Woy Woy, with a view to improving navigation.	Woy Woy	NSW Government		**Not Commenced / Outstanding**	
W21	Sedimentary Processes	Dredge from the Correa Bay boat ramp to the entrance of Woy Woy Creek, to extend 300m up the creek channel, with a view to improving drainage and access at this location.	Woy Woy	NSW Government		**Completed**	Correa bay Dredging Feasability Study undertaken in 2015. Project concluded that dredging was cost prohibitive due to PASS and environmental approvals required (being partly SEPP14 wetland).
W23	Sedimentary Processes	Deepen and widen the outlets of Mudflat and RSL Creeks in Hardys Bay so that both creeks restore tidal flushing. The efficacy of this option in improving flushing should be assessed prior to undertaking the works.	Mudflat and RSL Creeks	NSW Government		**Completed**	
W24	Sedimentary Processes	Deepen and widen the entrance to Hardys Bay to permit greater tidal flushing. The efficacy of this action in improving flushing should be assessed prior to undertaking the works. In addition, the environmental aspects must also be considered.	Hardys Bay	NSW Government		**Not Commenced / Outstanding**	
W25	Sedimentary Processes	Dredge in the Saratoga (Paddy's and Lintern) Channel(s) and around the boat ramps to permit better access.	Saratoga and Green Point	NSW Government		**Not Commenced / Outstanding**	
W26	Sedimentary Processes	Rehabilitate the eroding foreshores on the eastern shores of Hardys Bay with natural vegetation typical of that naturally occurring in the area. Where this is not feasible, investigate environmentally friendly seawall options.	Eastern shores of Hardys Bay	GCC	Volunteers	**Not Commenced / Outstanding**	Foreshore assessed as part of estuary-wide prioritisation matrix. No works programmed to date.
W27	Sedimentary Processes	Undertake regular maintenance to remove sediments from the outlets of stormwater drains.	Catchment-wide	GCC		**Implemented and Ongoing**	Commenced and ongoing. Storm water drain outlets maintained regularly, subject to licences and approvals.

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
W28	Sedimentary Processes	Undertake beach re-nourishment works at Ettalong Beach for the purposes of beach amenity and foreshore protection.	Ettalong Beach	GCC	DPI (Crown Lands Division)	**Implemented and Ongoing**	Beach nourishment undertaken in 2012/13 following REF and approvals being sought. Ongoing visual monitoring underway to determine future nourishment regime.
W29	Sedimentary Processes	Implement shoreline protection works which incorporate environmentally friendly design features.	Ettalong Beach	GCC	OEH, DPI (Crown Lands Division)	**Completed**	Ferry Park seawall constructed in 12/13. Lance Webb Reserve seawall constructed in 15/16.
W30	Sedimentary Processes	Remove the sandstone and cement abutments from the Pretty Beach jetty and adjacent to the pool.	Pretty Beach	GCC		**Not Commenced / Outstanding**	
W31	Sedimentary Processes	Investigate options to address the accretion of sediments along the eastern shoreline along Pretty Beach, including those that have built up in the swimming pool.	Pretty Beach	GCC		**Not Commenced / Outstanding**	An estuary wide Water Quality Improvement Plan is required which would be informed by existing information and detailed audits of each sub-catchment. This plan would help to guide implementation of WSUD infrastructure. HIGH PRIORITY ACTION
W32	Sedimentary Processes	Dredge sediments around the boat launching pontoon at Pretty Beach to enable boats to tie up on both sides of the pontoon.	Pretty Beach	NSW Government		**Not Commenced / Outstanding**	
W33	Sedimentary Processes	Reinstate a vegetated, sandy shoreline at Pretty Beach similar to that present prior to the construction of Pretty Beach Road. The use of mangroves for revegetation works is discouraged due to their potential to outcompete and displace saltmarsh.	Pretty Beach	GCC	Volunteers	**Not Commenced / Outstanding**	Foreshore assessed as part of estuary-wide prioritisation matrix. No works programmed to date.
W34	Sedimentary Processes	Identify locations of bank erosion along creekline corridors and the Estuary foreshore. Design and implement remediation measures to address these issues, with re-establishment of native vegetation being the preferred option where feasible. Reference should be made to the shoreline assessment provided in Appendix H of the Estuary Processes Study (Cardno, 2008) along with the Narara Creek and Erina Rivercare Plans.	Erina, Narara, Woy Woy, Hardys Bay and Kincumber Creeks as a priority	GCC	NOW, OEH	**Implemented and Ongoing**	Estuary foreshore prioritisation is completed and included in CPS. Creeks not yet fully addressed. HIGH PRIORITY ACTION
W35	Sedimentary Processes	Investigate appropriate sediment control works to address sediment accretion issues at St Huberts Island.	St Huberts Island	GCC		**Completed**	Plan of Management for the St Huberts Island Canals is in preparation. PoM due to be finished 17/18. Works to be implemented as required. Most works identified in the PoM are likey to be undertaken by private landowners via the DA process.
W38	Sedimentary Processes	Implement shoreline protection works (to include plantings) to address the erosion and foreshore inundation along the foreshore at Yattalunga Reserve.	Yattalunga	GCC		**Completed**	Complete.
W39	Sedimentary Processes	Rehabilitate eroded foreshore near 29 Araluen Drive, Killcare.	Killcare	GCC		**Not Commenced / Outstanding**	Foreshore assessed as part of estuary-wide prioritisation matrix. No works programmed to date.

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
W41	Sedimentary Processes	Undertake foreshore stabilisation works in the Punt Bridge area incorporating revegetation to address erosion issues.	East Gosford	GCC	Volunteers	**Not Commenced / Outstanding**	Foreshore assessed as part of estuary-wide prioritisation matrix. No works programmed to date.
W43	Sedimentary Processes	Develop and implement a long term solution to replace the currently failing seawall in Memorial Park on Brick Wharf Road. Any option identified should wherever possible incorporate environmentally friendly features.	Woy Woy	GCC	OEH	**Completed**	Complete. 2014/15 year.
W44	Sedimentary Processes	Replace the collapsed stormwater drain running between the two ovals in Austin Butler Reserve and remove accreted sediments. There is a preference for the use of a natural vegetated swale and/or small wetland.	Woy Woy	GCC		**Not Commenced / Outstanding**	
W45	Sedimentary Processes	Undertake foreshore stabilisation works to address erosion currently occurring in Palermo Reserve, Empire Bay Drive.	Daleys Point	GCC		**Not Commenced / Outstanding**	Foreshore assessed as part of estuary-wide prioritisation matrix. No works programmed to date.
W46	**Sedimentary Processes**	**Investigate the cause of erosion around the Blackwall Point boat ramp and develop measures to address this issue. Any necessary repairs to stabilise the foreshore and the adjacent roadway should be undertaken.**	**Blackwall**	**GCC**		**Completed**	Roads & Drainage completed this project in 2017/18(?). Details to be obtained.
W47	Sedimentary Processes	Investigate appropriate and cost effective methods to remediate any scouring currently occurring of the existing seawall at Illoura Reserve, Davistown.	Davistown	GCC		**Not Commenced / Outstanding**	Foreshore assessed as part of estuary-wide prioritisation matrix. No works programmed to date.
W48	Sedimentary Processes	Enhance foreshore vegetation to prevent further erosion of Illoura Reserve between Lintern Street and Malinya Road, Davistown, and along the western/northern foreshore of Kincumber Broadwater.	Davistown	GCC	Volunteers	**Not Commenced / Outstanding**	
W49	Sedimentary Processes	Implement foreshore stabilisation works to prevent further erosion of the shoreline near Rip Road Reserve.	Blackwall	GCC	Volunteers	**Implemented and Ongoing**	Contract for development of detailed design awarded to Haskoning Australia in February 2019.
W50	Sedimentary Processes	Undertake minor dredging works to improve access to the Centennial Street boat ramp.	Saratoga	NSW Government		**Not Commenced / Outstanding**	
W51	Sedimentary Processes	Implement measures to dissipate the energy of stormwater flows and prevent scour associated with the stormwater outlet near the corner of Jirramba and Mimosa Avenues.	Saratoga	GCC		**Not Commenced / Outstanding**	
W52	Sedimentary Processes	Investigate and implement measures to address siltation currently occurring in the open drain along the foreshore between Mundoora Access and Wilkie King Avenue. Both removal of the accreted sediments and measures to address sediment sources should be considered. There is a preference for the use of a natural vegetated swale and/or small wetland.	Yattalunga	GCC		**Not Commenced / Outstanding**	
W53	Sedimentary Processes	Undertake bank stabilisation works to address the erosion occurring in the creek in the region of Avoca and Sun Valley Drives.	Green Point	GCC		**Not Commenced / Outstanding**	Green Point area included in CPS. Generally a high priority foreshore.
W54	Sedimentary Processes	Investigate and implement measures to address the eroding seawall located near Araluen Drive on the southern side of Hardys Bay. Preferred options include re-establishment of native vegetation or an environmentally friendly seawall.	Hardys Bay	GCC		**In progress / Incomplete**	Hardys Bay area included in CPS. Generally a high priority foreshore. Concept design for Hardy's Bay to be undertaken 2017/18

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
W55	Sedimentary Processes	Identify the cause of foreshore erosion in Lance Webb Reserve and develop and implement measures to stabilise the foreshore.	Ettalong	GCC		**Completed**	Beach nourishment undertaken in 2012/13 following REF and approvals being sought. Ongoing visual monitoring underway to determine future nourishment regime. Lance Webb Reserve seawall constructed in 15/16.
W58	Foreshore Flooding/Inundation	Control mangrove growth where they are affecting key drainage channels. This should be undertaken (where permissable) under the relevant permit or licence.	Catchment Tributaries	GCC	DPI (Fisheries), Volunteers	**In progress / Incomplete**	Ongoing Management subject to detailed Fisheries Licence. DETAILS OF PROGRAM BEING PROVIDED BY CHRIS COOMBS.
W59	**Foreshore Flooding/Inundation**	**Investigate the benefits of decommissioning the Woy Woy Creek dam at former abattoir site.**	**Woy Woy Creek**	**GCC**		**Not Commenced / Outstanding**	
W60	Foreshore Flooding/Inundation	Where possible, provide for managed retreat of infrastructure from foreshore areas likely to be affected by sea level rise on a regular basis.	Estuary Foreshores	GCC, Asset Owners	OEH	**Implemented and Ongoing**	A key recommendation (PM9) of the BWFRMP. The projected impacts of sea level rise on the following assets could be incorporated into the investigations: • Public infrastructure – investigate the long term viability of the infrastructure servicing potentially affected areas. Strategies should be identified for works to protect these assets from the impacts of sea level rise and how this may be incorporated into the existing maintenance regime. Trigger levels should be identified when infrastructure is no longer viable (e.g. tidal levels at which road surfaces need to be upgraded / raised due to increasing frequent inundation).
W63	**Foreshore Flooding/Inundation**	**Investigate and implement options to address the issue of drainage from private properties along Mundoora Avenue onto the public reserve.**	**Yattalunga**	**GCC**		**Completed**	Incorporated in shoreline stabilisation project 2010/11. Total cost of foreshore works incorporating drain reclamation shown to right.
W64	**Foreshore Flooding/Inundation**	**Undertake to improve drainage in the creek by dredging accreted sediments near Avoca and Sun Valley Drives.**	**Green Point**	**GCC**		**Not Commenced / Outstanding**	
W65	Habitat and Species Conservation	Replace existing swing moorings within the Estuary with more appropriate, seagrass friendly moorings.	Waterway-wide	NSW Maritime		**In progress / Incomplete**	Extensive trials have been undertaken but no clear direction in place at the moment.
W66	Habitat and Species Conservation	Provide fish friendly structures where new instream structures are being constructed.	Catchment Tributaries	GCC, RTA	DPI (Fisheries)	**Implemented and Ongoing**	
W67	Habitat and Species Conservation	Identify existing instream infrastructure (e.g. weirs and culverts) for replacement or retrofitting to fish friendly status.	Catchment Tributaries	GCC, RTA	DPI (Fisheries)	**Not Commenced / Outstanding**	

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
W69	Habitat and Species Conservation	Review condition of existing sea walls in Council's foreshore parks to investigate possibility of returning natural foreshore and/or use of alternative materials in line with DECC's Environmentally Friendly Seawalls guidelines (2009).	Estuary Foreshores	GCC	DPI (Crown Lands Division), OEH, CMA	**In progress / Incomplete**	Foreshore condition assessment undertaken and montoring underway. Work priortisation matrix developed to guide works and funding bids. Current projects include: Elfin Hill Road Reserve Green Point - Tender for construction awarded to Scape Constructions February 2019 Captain Cook Reserve Green Point - finalising detailed design and community consultation materials (as of February 2019) Rip Road Reserve Blackwall - contract for detailed design awarded to Haskoning Australia February 2019.
W70	Habitat and Species Conservation	Fence existing saltmarshes to prevent access by vehicles, bikes and domestic animals and provide information on the importance of saltmarsh habitat to estuary health.	Estuary Foreshores	GCC	CMA, Bushcare Volunteers	**Implemented and Ongoing**	Fencing installed at Kylie Close and Calool Street Bensville - 2009/10. Bollards installed Romford Close Davistown 2009/10.
W71	Habitat and Species Conservation	Where appropriate, rehabilitate saltmarsh habitats on an Estuary-wide basis. Rehabilitation works should be prioritised with due consideration of habitat connectivity, and the potential for ongoing conservation in both the medium-term and long-term (i.e. under a climate change scenario).	Estuary-wide	GCC	OEH, CMA, Bushcare Volunteers	**Implemented and Ongoing**	Wetland inventory commenced 2016/17, 95% complete. This will inform a wetland management and prioritisation plan to update existing wetland management study prepared in the 1990's. Works have been undertaken in several locations around the estuary including: Kylie Close wetlands Bensville (commenced in 2011), currently funded via an estuary Management Grant from OEH; Davistown Wetlands at Romford Close (commenced 2011, dormant site); Pateman Road Wetlands Erina (commenced 2011) , currently funded via an estuary Management Grant from OEH; Tascott Creek (commenced 2011), funding provided via Opex 17/18 to do maintenance; Coorumbine Creek Point Clare (commenced 2011), further funding to be allocated via opex 17/18; Saratoga Wetlands to be commenced October 2017 with opex funding. Funding: 2010/11 - capital works allocation of $60,000. 2012/13 - Fish Habitat Action grant - $34,000. 2015/16-18/19 - Estuary Management Grant - $50,000 (over 3 years) 2016/17 - Opex allocation of $160,000 Volunteers There are several volunteer groups working within wetland areas in BW catchment with support via the Council Volunteer Bushcare Program

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
W73	Habitat and Species Conservation	Continue weed control activities in Council's foreshore reserves.	Estuary Foreshores	GCC	Bushcare Volunteers	**Implemented and Ongoing**	Wetland restoration program commenced 2011
W77	Habitat and Species Conservation	Investigate alternative dinghy storage options/locations to provide suitable storage facilities located near the Scout Hall on Mason Parade, Gosford.	Mason Parade, Gosford	GCC		**Completed**	Dinghy storage facilities constructed with part funding via the NSW Government Better Boating Program (BPP).
W81	Recreational Usage	Seek to provide additional facilities for the boating community to include slipways, shipwright services, travel lifts, re-fuelling areas and hard stand areas. The form and location of these additional facilities should be such that they are accessible by a range of vessels over the full tidal cycle.	Estuary Foreshores / Waterway-wide	DPI (Crown Lands Division)	GCC	**Not Commenced / Outstanding**	
W82	Recreational Usage	Seek to provide a publicly accessible pathway along the entire Estuary foreshore. This should be approached in a strategic fashion incorporating: a) Linkages with existing cycleways, pathways and public transport in the wider catchment, b) Safety by Design (e.g. through the provision of lighting), and c) Consideration of environmental constraints (e.g. gridded/light permeable boardwalks may be more suitable in ecologically sensitive areas).	Estuary Foreshores	GCC	DPI (Crown Lands Division)	**Implemented and Ongoing**	Commenced and ongoing. Kincumber, Ettalong, Woy Woy, Refer to Gosford to Point Clare cycleway/ ped link Feasability Study May 2013 IR 14071593 and Empire Bay Dr Shared path way Planning Study August 2013 IR14512484 and Avoca Dr Shared pathway Planning Study May 2013 IR14512709 ACTUAL COSTS TO BE SOUGHT FROM CONSTRUCTION PLANNING AND MANAGEMENT
W83	Recreational Usage	Identify priority, privately owned/managed parcels of foreshore land for acquisition and/or incorporation into publicly accessible foreshore land.	Estuary Foreshores	GCC	DPI (Crown Lands Division)	**Not Commenced / Outstanding**	
W84	Recreational Usage	Provide boardwalks at sensitive foreshore locations to permit public access.	Estuary Foreshores	GCC		**Implemented and Ongoing**	2012/13 - Boardwalk constructed through wetland between Magnolia Avenue and Kincumber Crescent, Davistown. This boardwalk has reduced impact on the wetland from informal access and has provided all weather access across the wetland for the community. Project was initially initiated by Davistown Wetlands Bushcare.
W85	Recreational Usage	Enforce the replacement of fixed public jetties with floating pontoons (where feasible) with transparent or mesh deck materials to permit light penetration in areas containing seagrass habitat.	Waterway-wide	DPI (Crown Lands Division)	GCC	**Implemented and Ongoing**	There is an on-going maitenance program for Council managed public jetties. Mesh decking and floating pontoons are used on all public jetty upgrades.
W87	Recreational Usage	Ensure that the navigation markers are moved, or new markers put in place as required, in accordance with movement of the associated shoals.	Waterway-wide	NSW Maritime		**Implemented and Ongoing**	This is implemented on an ongoing basis and based on site specific scenarios.
W89	Recreational Usage	Provide additional off-leash dog walking areas in areas which do not impact upon threatened and protected flora and fauna.	Catchment-wide	NSW Government		**Completed**	Review of dog exercise policy completed in 2014/15
W91	Recreational Usage	Provide bins and bags for the disposal of animal faeces by dog walkers.	Catchment-wide	GCC		**Completed**	Subject to dog exercise policy reviewed in 2013/14, 2014/15.
W93	Recreational Usage	Provide additional rubbish and recycling bins along the foreshore, focusing on access points and targeting heavily utilised foreshore reserves as a priority.	Estuary Foreshores	GCC		**Unknown**	INPUT FROM WASTE SERVICES REQUIRED
W94	Recreational Usage	Provide additional facilities for disabled and less mobile people, to include access ramps, seating, disabled parking, etc.	Fagans Bay, Woy Woy, Ettalong	GCC		**Not Commenced / Outstanding**	
W96	Recreational Usage	Provide short-term 'loading zones' for recreational users (un)loading bikes or other equipment immediately adjacent to heavily utilised recreational sites.	Estuary Foreshores	GCC		**Not Commenced / Outstanding**	

Brisbane Water Coastal Zone Management Plan							
ID	**Management Goal**	**Strategy Outline**	**Location**	**Primary Resp.**	**Supporting**	**Status**	**Comments**
W98	Recreational Usage	Provide additional public open space areas incorporating walking tracks in the Woy Woy area (to the waterfall and through the former abattoir site).	Woy Woy	GCC		**Not Commenced / Outstanding**	

Pittwater Estuary Management Plan							
ID	*Strategy*	*Management Strategy*	*Priority*	*Responsibility*	*Support Responsibilities*	*Status*	*Comments*
1a	Prepare and implement Plans of Management to define land management for Church Pt, Palm Beach Wharf / Pittwater Park, Scotland Island and western offshore communities	Land Management Controls	High	Council	Dept of Lands	**Implemented and Ongoing**	Foreshore and infrastructure development undertaken in accordance with Church Point PoM
1b	Update and implement Plan of Management for Careel Bay wetlands, ensuring maintenance of habitat mix / diversity (which may include selective removal of mangrove seedlings that have encroached onto saltmarsh areas from time to time)	Land Management Controls	High	Council	DECCW, DII (Fisheries), HNCMA	**Not Commenced / Outstanding**	
1c	Prepare and implement Plans of Management for areas of significant habitat (eg EECs) on public land and DCPs for private lands ensuring preservation and enhancement of key environmental values	Land Management Controls	High	Council	DECCW, DII (Fisheries) HNCMA	**In progress / Incomplete**	
2a	Significant environmental values are to be identified and are adequately protected within appropriate planning instruments (including foreshore areas, EECs, vegetation stands). Eg, modify SEPP-14 wetland boundaries, TPOs.	Planning Controls	Medium	Council	DECCW, DII (Fisheries), HNCMA, and DP	**In progress / Incomplete**	
2b	Areas of significant heritage value (Aboriginal and early-European) are to be identified and to be adequately protected within appropriate planning instruments, such as Council's LEP (first requires assessment of Aboriginal and early-European sites)	Planning Controls	Low	Council, DECCW	HNCMA, Historical Societies, NSW Heritage Council	**In progress / Incomplete**	
2c	Extend public conservation area lands (eg State Park), to include parts of Currawong and Mackerel Beach for example	Planning Controls	Medium	Council	DECCW (NPWS), DP and Dept of Lands.	**Implemented and Ongoing**	Currawong site has been acquired by a State Park managed by Council
2d	Allow small scale maintenance dredging for navigational safety, providing it does not conflict with or compromise existing or future environmental values.	Planning Controls	Low	Individual boat owners who will benefit from dredging and NSW Maritime	NSW Maritime	**Implemented and Ongoing**	Applies to navigational channels only and does not include embayments for boat mooring
3a	Climate change impacts for development are to be considered and addressed, with the development of relevant risk management plans for adoption into Council's DCP	Development Controls	Medium	Council	DECCW, HNCMA	**Implemented and Ongoing**	
3b	WSUD principles to be added to all development controls (draft DECC DCP)	Development Controls	High	Council		**Implemented and Ongoing**	
3c	Appropriate on-site sewage systems to be adopted, suitable for soils, topography etc	Development Controls	Medium	Council, Sydney Water		**Implemented and Ongoing**	For unsewered sites only. Existing systems regularly impacted for compliance
3d	Developments not to incorporate pollution and/or sediment discharges to the waterways	Development Controls	High	Council		**Implemented and Ongoing**	
3e	Developments not to degrade scenic amenity of the Pittwater estuary and surrounds	Development Controls	Medium	Council		**Implemented and Ongoing**	
3f	Public amenity and existing foreshore values to be retained / improved for foreshore developments	Development Controls	Medium	Council		**Implemented and Ongoing**	
3g	Make stricter sediment & erosion controls for developments	Development Controls	Medium	Council		**Implemented and Ongoing**	
3h	Require all new marina developments (> 9 berths) to have pump-out services	Development Controls	High	Council		**In progress / Incomplete**	Two marinas in Pittwater currently provide boat pump-out services
4a	Limit proximity of boating activities to environmentally significant areas and other sensitive areas (eg infested areas), incl. no anchoring	Acitvty Controls / Modifications	Medium	NSW Maritime	Council, Fisheries	**Not Commenced / Outstanding**	
4b	Replace existing moorings with seagrass friendly moorings in areas close to existing seagrass beds	Acitvty Controls / Modifications	Medium	HNCMA, NSW Maritime	Council, Fisheries	**Implemented and Ongoing**	Some seagrass friendly moorings have been trialled in Careel Bay

Pittwater Estuary Management Plan							
4c	If necessary, reduce boating speed limits in areas of high waterway use / traffic (eg western side of Scotland Island)	Acitvty Controls / Modifications	Low	NSW Maritime		**Not Commenced / Outstanding**	
4d	If necessary, relocate existing moorings away from areas of high environment significance and/or high vessel traffic	Acitvty Controls / Modifications	Low	NSW Maritime	Council, Fisheries	**Not Commenced / Outstanding**	
4e	Remove significant impediments to fish passage	Acitvty Controls / Modifications	Low	DII (Fisheries)	HNCMA, Council and DECCW	**Implemented and Ongoing**	
4f	Encourage all existing large marinas (> 30 berths) to install pump-out services	Acitvty Controls / Modifications	Medium	Council	DECCW (EPA) and NSW Maritime	**Implemented and Ongoing**	
4g	If necessary, reduce the total number of moorings within Pittwater to a more appropriate capacity / mooring limit, through opportunistic relinquishment and offsets through new marina developments.	Acitvty Controls / Modifications	Medium	NSW Maritime		**Implemented and Ongoing**	
5a	Install new and/or upgrade and repair existing waterway access locations / points, and foreshore access and facilities, giving consideration to the environment	New / Imporved Services and Assets	Low	Council	DECCW, DII (Fisheries), HNCMA, and NSW Maritime	**Implemented and Ongoing**	
6a	Repairs / rehabilitation of significant heritage sites (Aboriginal and/or early European)	Environmental and Heritige Rehabilitation	Low	Council	DECCW, Dept of Lands, HNCMA	**Implemented and Ongoing**	Appropriate development controls applied to development affecting known Aboriginal and European Heritage sites
6b	Redress erosion along Pittwater foreshores and along catchment streams / tributaries	Environmental and Heritige Rehabilitation	Medium	Council	DECCW, Dept of Lands, HNCMA	**Implemented and Ongoing**	Beach erosion has become a significant problem around the Pittwater foreshores in recent years
6c	Re-vegetation along estuary foreshores and along riparian zones within catchment (on both public and private lands) to connect habitats, provide shade and enhance ecological communities (esp. EECs)	Environmental and Heritige Rehabilitation	Medium	Council	HNCMA	**Implemented and Ongoing**	Work is currently undertaken at selected foreshores sites by contractors and Landcare volunteers
6d	Weed and exotic species control, including Caleurpa taxifolia.	Environmental and Heritige Rehabilitation	Medium	Council	HNCMA, Fisheries	**In progress / Incomplete**	Fisheries undertakes control of Caulerpa taxifolia for new infestations only
7a	Targeted measures for reducing marina operations waste	Pollution reduction Measures	High	Council	DECCW (EPA), DII (Fisheries), NSW Maritime	**Implemented and Ongoing**	In response to observed pollution or as a result of customer requests
7b	Targeted catchment management measures, following catchment-wide urban pollution and sediment runoff audit (esp. areas discharging to poorly flushed embayments)	Pollution reduction Measures	High	Council	DECCW Landowners	**Implemented and Ongoing**	A number of tributaries to the Pittwater waterway are regularly monitored for water quality
7c	Minimise overflows from the reticulated sewerage system (through Sydney Water consultation)	Pollution reduction Measures	Medium	Sydney Water	Council, DECCW (EPA), Department of Health	**In progress / Incomplete**	
8a	Community Education - No discharge status of Pittwater	Community Education	Medium	NSW Maritime	Council	**Implemented and Ongoing**	
8b	Community Education - Discouragement of use of high-pollution older-style 2 stroke outboard motors	Community Education	Medium	NSW Maritime	Council	**Not Commenced / Outstanding**	
8c	Community Education - Catchment management for waterway health and biodiversity	Community Education	Medium	Council	HNCMA, DECCW	**Implemented and Ongoing**	
8d	Community Education - Appropriate foreshore use (including education of foreshore landowners)	Community Education	Medium	Council	HNCMA, DII (Fisheries), NSW Maritime	**In progress / Incomplete**	
8e	Community Education - Aboriginal values	Community Education	Low	Council	HNCMA	**In progress / Incomplete**	Including the involvement of the Aboriginal Heritage Office in the assessment of DAs
8f	Community Education - General environmental values of estuary	Community Education	High	Council	HNCMA, DECCW	**Implemented and Ongoing**	

Pittwater Estuary Management Plan							
9a	Compliance: Permanent occupancies on boats	Compliance	Medium	NSW Maritime	Council	**Implemented and Ongoing**	Involves NSW Maritime for moored vessels
9b	Compliance: Boating regulations, ie speeds, dangerous behaviour, Caleurpa controls / washdown	Compliance	Medium	NSW Maritime	Council	**Implemented and Ongoing**	Largely undertaken by NSW Maritime and NSW Fisheries
9c	Compliance: Sediment and erosion controls, as well as other development controls / conditions	Compliance	Medium	Council		**Implemented and Ongoing**	
9d	Compliance: On-site sewage systems operation	Compliance	Medium	Council		**Implemented and Ongoing**	Regular inspections by Council's Environmental Compliance Officers
9e	Compliance: Water pollution from boats and waterway businesses (e.g. marinas)	Compliance	High	NSW Maritime	Council	**Implemented and Ongoing**	

Upper Hakesbury River Estuary CZMP							
ID	*Action*	*Action Sub-Plan*	*Priority*	*Lead Responsibilities*	*Support Responsibilities*	*Status*	*Comments*
WQ1	Write a specific WSUD chapter in Hawkesbury DCP	Strategic Planning	High	HCC	OEH, DPI, GSLLS	**In progress / Incomplete**	Draft LSPS includes provisions - updated LEP and DCP to be completed by June 2021
WQ2	Review and update erosion and sediment control information and requirements in Hawkesbury DCP	Strategic Planning	Very High	HCC	HRCC, DPI, GSLLS	**In progress / Incomplete**	Updated LEP & DCP to be completed by June 2021
WQ3	Review and update Hawkesbury DCP in relation to rural lands to incorporate best practice land management to reduce sediment and nutrient loads	Strategic Planning	Very High	HCC	HRCC, GSLLS	**In progress / Incomplete**	Rural Lands Study nearing completion
WQ4	Undertake an education program for works staff involved in sediment and erosion control	Strategic Planning	High	HCC	GSLLS	**Not Commenced / Outstanding**	No funding
WQ5	Enforce implementation and maintenance of effective sediment controls during subdivision and building phases of all developments (including infrastructure projects)	Regulatory and Environmental Services	High	HCC		**In progress / Incomplete**	Ongoing
WQ6	Undertake adequate and appropriate maintenance of existing WSUD devices to maintain their effectiveness, in particular GPTs, nutrient filters and other stormwater quality improvement devices	Infrastructure Services	High	HCC	HRCC, GSLLS	**Implemented and Ongoing**	
WQ7	Utilise hydrodynamic and water quality model being developed for Sydney Water to understand potential sea level rise impacts on salinity profile	Design and Mapping	High	HCC	Sydney Water, GSLLS, OEH	**In progress / Incomplete**	
WQ8	Implement an estuary health monitoring program and issue biennial report cards	Parks and Recreation	High	HCC	OEH, SCA	**Implemented and Ongoing**	
ARH1	Continue to support the implementation of the River Health Strategy to benefit the estuary	Strategic Planning	Very High	HCC	HRCC, GSLLS	**Implemented and Ongoing**	
ARH2	Prepare a species planting fact sheet for applicants and Council officers for use in development assessment of foreshore works	Parks and Recreation	Very High	HCC	HRCC, GSLLS, Willow Warriors	**Not Commenced / Outstanding**	No funding
ARH3	In accordance with the HNCAP 2013-2023, identify locations for and undertake targeted rehabilitation, creation and enhancement of estuarine and floodplain wetland communities and adjacent riparian vegetation	Parks and Recreation	High	HCC	HRCC, GSLLS, OEH	**Implemented and Ongoing**	
ARH4	Actively support the continuation of Bush Care to assist with revegetation works on public land	Parks and Recreation	High	HCC	HRCC, GSLLS	**Implemented and Ongoing**	
ARH5	Council to contact new riparian land owners with a ‘Welcome Pack’ and encourage grant based rehabilitation initiatives	Strategic Planning	Moderate	HCC	GSLLS	**In progress / Incomplete**	HCC wide welcome pack project has commenced and will be tailored to match locations
ARH6	Coordinate weed management efforts between the County Council, Bushcare and Landcare (including Willow Warriors) and the LALC to maximise benefits for the estuary	Parks and Recreation	Moderate	HCC, HRCC	NPWS, Crown Land, RMS, Hawkesbury Bush Care, Willow Warriors	**Implemented and Ongoing**	
RA1	Increase surveillance and monitoring activities on the river for pollution and dumping	Regulatory and Environmental Services	High	HCC, DPI, EPA, RMS	Bush Care, HRCC, Land Care, Willow Warriors.	**Not Commenced / Outstanding**	No funding
RA2	Employ a River Keeper	Parks and Recreation	High	HCC	RMS, HRCC, HSC	**Not Commenced / Outstanding**	
RA3	Undertake a noncompliance audit of unauthorised activities on riparian public land	Regulatory and Environmental Services	High	HCC	Crown Lands, DPI, RMS	**In progress / Incomplete**	Ongoing program

Upper Hakesbury River Estuary CZMP							
RA4	Increase opportunities for passive recreation and support current levels of active recreation	Strategic Planning and Parks and Recreation	Moderate	HCC	Crown Lands, DPI, RMS	**Implemented and Ongoing**	
LPD1	Prepare a public fact sheet to indicate how Council will continually assess the likely impacts of development upon the natural values and sustainability of the Upper Hawkesbury River Estuary	Development Services	Very High	HCC	DoPI	**Implemented and Ongoing**	
LPD2	Develop education and awareness of the Action Plans within the CZMP and the way they should be applied across the organisation	Strategic Planning	Very High	HCC	DoPI, DPI	**Implemented and Ongoing**	Prior to Gazettal of CZMP Departments advised of responsibilities
LPD3	Review and update the Hawkesbury DCP to give greater protection to estuary assets	Strategic Planning	Very High	HCC	OEH, DPI	**In progress / Incomplete**	Updated LEP and DCP to be completed by June 2021
LPD4	Audit and review of river-side caravan parks. Map caravan park locations, clearly define regulations and identify opportunities to reduce impacts.Prepare Landscape Management Plan Guidelines.	Regulatory and Environmental Services	Very High	HCC	Crown Lands, NPWS, The Hills Shire Council	**In progress / Incomplete**	also ties in with Flood Risk Management works
LPD5	Provide development assessment fact sheet or checklist for subdivisions	Development Services	Moderate	HCC		**Implemented and Ongoing**	Ongoing review and refinement
LPD6	Explore the potential of working groups between Councils within the catchment in relation to landuse planning and development	Strategic Planning	High	HCC	The Hills Shire Council, Hornsby Council	**In progress / Incomplete**	Western Sydney Councils- City Deal and Western City District Plan
FP1	Prepare fact sheet on appropriate structures on river corridor.	Development Services	High	HCC	OEH	**In progress / Incomplete**	
FP2	Prepare advice fact sheets for the community on the management of foreshore land	Development Services	High	HCC	OEH, Other Councils	**In progress / Incomplete**	
FP3	Review and update Hawkesbury DCP to include a new chapter on foreshore management	Strategic Planning	High	HCC	OEH	**In progress / Incomplete**	Updated LEP and DCP to be completed by June 2021
FP4	Prepare a factsheet for website on Environmentally Friendly Seawalls in the Upper Hawkesbury River	Development Services and Strategic Planning	High	HCC	OEH, GSLLS	**Not Commenced / Outstanding**	
FP5	Ensure that Council is following guidelines on best practice foreshore management	Parks and Recreation	High	HCC, GSLLS	OEH	**Implemented and Ongoing**	
FP6	Undertake foreshore management in areas currently experiencing bank erosion and instability and areas vulnerable to this in the future.	Parks and Recreation	Moderate	HCC	OEH, Crown Lands, GSLLS	**Implemented and Ongoing**	
FP7	Investigate potential causes of bank erosion along the River including the impact of boating activities in partnership with landowners, boat users and relevant agencies.	Strategic Planning and Parks and Recreation	Moderate	HCC	RMS,OEH, Crown Lands, GSLLS, Hornsby Council	**Unknown**	
CH1	Work with the Local Aboriginal Land Council and elders to identify opportunities to maximise benefits of rehabilitation works for cultural outcomes.	Parks and Recreation	High	HCC	LALC, GSLLS	**Implemented and Ongoing**	
CH2	Protect and enhance cultural heritage values	Parks and Recreation	Moderate	HCC	Local Historical Societies, GSLLS, Willow Warriors	**Implemented and Ongoing**	
SLR1	Incorporate sea level rise considerations into infrastructure asset management and planning processes and capital works design	Infrastructure Services	Moderate	HCC	OEH	**Not Commenced / Outstanding**	
SLR2	Map estuarine vegetation and assess vulnerabilities to future sea level rise	Strategic Planning and Parks and Recreation	High	HCC	NPWS, OEH	**Not Commenced / Outstanding**	

Upper Hakesbury River Estuary CZMP							
ME1	Erosion Monitoring	Strategic Planning	High	HCC	RMS	**Implemented and Ongoing**	
ME2	MOU between agencies regarding sharing of environmental health data	Strategic Planning	Moderate	HCC	SCA, DPI, Sydney Water, GSLLS, OEH, adjoining Councils	**Implemented and Ongoing**	
ME3	Continue to evaluate navigability issues and dredging feasibility	Strategic Planning	Moderate	HCC	RMS	**Completed**	Investigation into dredging completed and Council resolved to not proceed
ME4	Establish an Estuary Management Committee to guide holistic management of the estuary	Strategic Planning	High	HCC	OEH, GSLLS, DPI, The Hills Council, Hornsby Council, RMS, Sydney Water	**Not Commenced / Outstanding**	

APPENDIX F
FIRST PASS RISK ASSESSMENT

Threat	Stressor Category	ID	Stressor	Management Plans & Strategies to Address Threat							Present Day Residual Risk			Future Risk			Comments and Other Management Plans, Strategies and Programs to Adress Threat
				MEMS	UH CZMP	LH EMP	BW CZMP	PITT EMP	GB CZMP	Other↓	Likelihood	Conseq.	Present Risk	20 yr Risk	50 yr Risk	100 yr Risk	
Natural Hazards	Long Term Hazards	1.1	Tidal inundation of estuaries (i.e. sunny day flooding)			✓					Almost Certain	Major	High	High	High	High	DPIE Tidal Inundation Assessment 2018
Natural Hazards	Long Term Hazards	1.2	Estuary foreshore erosion and bank erosion	✓	✓	✓	✓	✓			Almost Certain	Major	High	High	High	High	
Natural Hazards	Long Term Hazards	1.3	Long-term coastal shoreline recession				✓	✓	✓		Likely	Moderate	Moderate	High	High	High	
Natural Hazards	Long Term Hazards	1.4	Estuary entrance instability						✓	✓	Possible	Moderate	Low	Low	Low	Low	Pearl Beach Lagoon CZMP
Natural Hazards	Long Term Hazards	1.5	Cliff and slope instability			✓			✓		Unlikely	Moderate	Minimal	Low	Moderate	Moderate	
Natural Hazards	Event Based Hazards	2.1	Coastal storm impacts - erosion	✓				✓	✓		Likely	Major	High	High	High	High	
Natural Hazards	Event Based Hazards	2.2	Coastal storm impacts - inundation	✓			✓	✓	✓		Likely	Major	High	High	High	High	
Natural Hazards	Event Based Hazards	2.3	Combined coastal and catchment flooding	✓	✓				✓	✓	Almost Certain	Major	High	High	High	High	Hawkesbury-Nepean Valley Regional Flood Study, 2019 Brisbane Water FRMSP
Natural Hazards	Event Based Hazards	2.4	Bushfire			✓		✓			Almost Certain	Major	High	High	High	High	Local Government Bushire Risk Management Plan's
Natural Hazards	Event Based Hazards	2.5	Drought							✓	Almost Certain	Moderate	Moderate	Moderate	Moderate	Moderate	The NSW Drought Strategy
Natural Hazards	Event Based Hazards	2.6	Tsunami							✓	Rare	Catastrophic	Low	Low	Low	Moderate	NSW State Tsunami Plan 2018 (exposure exacerbated by sea level rise)
Natural Hazards	Event Based Hazards	2.7	Dam breach / break							✓	Rare	Catastrophic	Low	Low	Low	Low	Dam Break Study for Mangrove Dam Warragamba Dam Failure Warning and Evacuation Planning
Natural Hazards	Climate Change Impacts	3.1	Altered ocean currents & nutrient inputs	✓			✓							Low	Low	Moderate	
Natural Hazards	Climate Change Impacts	3.2	Ocean temperature increase	✓						✓				Low	Moderate	High	Mapping and Responding to Coastal Inundation, Sydney Coastal Councils & CSIRO, 1, 2 and 3.
Natural Hazards	Climate Change Impacts	3.3	Ocean acidification	✓										Low	Low	Moderate	
Natural Hazards	Climate Change Impacts	3.4	Altered storm frequency & severity	✓		✓	✓	✓	✓	✓				Low	Moderate	High	Climate Change in the Hawkesbury Nepean Catchment, CSIRO, 2007
Natural Hazards	Climate Change Impacts	3.5	Altered hydrological regimes							✓				Moderate	Moderate	High	Hawkesbury-Nepean Catchment Action Plan 2013-2023 Climate Change in the Hawkesbury Nepean Catchment (CSIRO, 2007)
Natural Hazards	Climate Change Impacts	3.6	Sea Level Rise (SLR)	✓	✓	✓	✓	✓	✓	✓				Moderate	Moderate	High	Climate Change in the Hawkesbury Nepean Catchment (CSIRO, 2007)
Natural Hazards	Climate Change Impacts	3.7	Long term shoreline recession due to SLR		✓		✓	✓	✓	✓				Low	Moderate	High	Climate Change in the Hawkesbury Nepean Catchment (CSIRO, 2007)
Natural Hazards	Climate Change Impacts	3.8	Altered salinity levels / profile	✓	✓	✓				✓				Low	Low	Moderate	Climate Change in the Hawkesbury Nepean Catchment (CSIRO, 2007)
Natural Hazards	Climate Change Impacts	3.9	Habitat migration & squeeze	✓	✓	✓	✓	✓		✓				Low	Moderate	High	Climate Change in the Hawkesbury Nepean Catchment (CSIRO, 2007)

Threat	Stressor Category	ID	Stressor	Management Plans & Strategies to Address Threat							Present Day Residual Risk			Future Risk			Comments and Other Management Plans, Strategies and Programs to Adress Threat
				MEMS	UH CZMP	LH EMP	BW CZMP	PITT EMP	GB CZMP	Other↓	Likelihood	Conseq.	Present Risk	20 yr Risk	50 yr Risk	100 yr Risk	
Land Use Intensification & Environmental Impacts	Water pollution and sediment contamination	4.1	Urban stormwater discharge	✓	✓	✓	✓	✓	✓	✓	Almost Certain	Major	High	High	High	High	Hawkesbury-Nepean Catchment Action Plan 2013-2023 NSW Natural Resources MER Estuary Ecosystem Health Program Local Government Stormwater Management Plans / Policies SREP 20 - Hawkesbury-Nepean River 1997
Land Use Intensification & Environmental Impacts	Water pollution and sediment contamination	4.2	Agricultural runoff	✓	✓	✓				✓	Almost Certain	Major	High	High	High	High	Hawkesbury-Nepean Catchment Action Plan 2013-2023 NSW Natural Resources MER Estuary Ecosystem Health Program Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions (OEH, 2017).
Land Use Intensification & Environmental Impacts	Water pollution and sediment contamination	4.3	Industrial discharges	✓		✓				✓	Almost Certain	Moderate	Moderate	High	High	High	Hawkesbury-Nepean Catchment Action Plan 2013-2023 NSW Natural Resources MER Estuary Ecosystem Health Program Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions (OEH, 2017).
Land Use Intensification & Environmental Impacts	Water pollution and sediment contamination	4.4	Sewage effluent & septic runoff	✓	✓	✓	✓	✓		✓	Almost Certain	Major	High	High	High	High	Hawkesbury-Nepean Catchment Action Plan 2013-2023 NSW Natural Resources MER Estuary Ecosystem Health Program Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions (OEH, 2017). The NSW SepticSafe program
Land Use Intensification & Environmental Impacts	Water pollution and sediment contamination	4.5	Sediment contamination / pollution (ASS)	✓	✓	✓	✓	✓			Almost Certain	Major	High	High	High	High	
Land Use Intensification & Environmental Impacts	Water pollution and sediment contamination	4.6	Disturbance of contaminated sediment on seabed (e.g. dredging) and in terrestrial areas	✓		✓		✓	✓	✓	Likely	Moderate	Moderate	Moderate	Moderate	Moderate	NSW Coastal Dredging Strategy 2017-2026
Land Use Intensification & Environmental Impacts	Habitat Clearing / Disturbance	5.1	Foreshore / urban development	✓	✓	✓	✓	✓	✓	✓	Almost Certain	Moderate	Moderate	Moderate	High	High	Hawkesbury Nepean Catchment Action Plan 2013-2023 Local Government LEP's and DCPs SEPP (Coastal Management) 2018
Land Use Intensification & Environmental Impacts	Habitat Clearing / Disturbance	5.2	Stock related damage of riparian and marine vegetation	✓	✓	✓				✓	Almost Certain	Major	High	High	High	High	Upper Hawkesbury River Bank Erosion, Foreshore Structure and Weed Mapping, 2013;
Land Use Intensification & Environmental Impacts	Habitat Clearing / Disturbance	5.3	Clearing / disturbance of riparian and aquatic habitat including wetland drainage	✓	✓	✓	✓	✓		✓	Likely	Major	High	High	High	High	Hawkesbury Nepean Catchment Action Plan 2013-2023 Upper Hawkesbury River Bank Erosion, Foreshore Structure and Weed Mapping, 2013
Land Use Intensification & Environmental Impacts	Habitat Clearing / Disturbance	5.4	Clearing / disturbance of littoral rainforest habitat	✓				✓		✓	Possible	Moderate	Low	Low	Low	Low	SEPP (Coastal Management) 2018
Land Use Intensification & Environmental Impacts	Habitat Clearing / Disturbance	5.5	Clearing / disturbance of terrestrial habitat	✓	✓	✓	✓	✓	✓	✓	Likely	Moderate	Moderate	Moderate	Moderate	Moderate	SEPP (Coastal Management) 2018 Hawkesbury Nepean Catchment Action Plan 2013-2023 SEPP (Vegetation in Non-Rural Areas) 2017
Land Use Intensification & Environmental Impacts	Habitat Clearing / Disturbance	5.6	Introduction of invasive fauna pest species (e.g. carp, foxes, etc) and diseases (POMS)	✓	✓	✓				✓	Almost Certain	Major	High	High	High	High	Hawkesbury Nepean Catchment Action Plan 2013-2023 Greater Sydney Strategic Pest Animal Plan 2018-2023 NSW Oyster Industry Sustainable Aquaculture Strategy 2016
Land Use Intensification & Environmental Impacts	Habitat Clearing / Disturbance	5.7	Introduction of invasive flora pest species (e.g. aquatic weeds) and diseases	✓	✓	✓	✓	✓		✓	Almost Certain	Major	High	High	High	High	Hawkesbury Nepean Catchment Action Plan 2013-2023 Greater Sydney Regional Strategic Weed Management Plan 2017 - 2022 Upper Hawkesbury River Bank Erosion, Foreshore Structure and Weed Mapping, 2013;
Land Use Intensification & Environmental Impacts	Hydrologic Modifications	6.1	Increasing groundwater extraction / use			✓		✓		✓	Likely	Moderate	Moderate	Moderate	Moderate	Moderate	Hawkesbury Nepean Catchment Action Plan 2013-2023 Greater Metropolitan Regional Water Sharing Plan (GMRWSP) Central Coast Water Sharing Plan
Land Use Intensification & Environmental Impacts	Hydrologic Modifications	6.2	Modified freshwater flows (in estuaries)	✓	✓	✓	✓			✓	Almost Certain	Moderate	Moderate	High	High	High	Hawkesbury Nepean Catchment Action Plan 2013-2023
Land Use Intensification & Environmental Impacts	Hydrologic Modifications	6.3	Sedimentation & infilling channels and changing flows	✓	✓	✓	✓	✓	✓	✓	Almost Certain	Major	High	High	High	High	NSW Coastal Dredging Strategy 2017-2026

Threat	Stressor Category	ID	Stressor	Management Plans & Strategies to Address Threat							Present Day Residual Risk			Future Risk			Comments and Other Management Plans, Strategies and Programs to Adress Threat
				MEMS	UH CZMP	LH EMP	BW CZMP	PITT EMP	GB CZMP	Other↓	Likelihood	Conseq.	Present Risk	20 yr Risk	50 yr Risk	100 yr Risk	
Land Use Intensification & Environmental Impacts	Hydrologic Modifications	6.4	Navigation & entrance management and modification	✓		✓	✓	✓	✓	✓	Almost Certain	Moderate	Moderate	Moderate	Moderate	Moderate	NSW Coastal Dredging Strategy 2017-2026
Resource Use & Conflict	Commercial Fishing & Boating	7.1	Commercial fishing in coastal waters	✓						✓	Almost Certain	Moderate	Moderate	Moderate	Moderate	Moderate	Social and Economic Evaluation of NSW Coastal Professional Wild-Catch Fisheries SEPP (Primary Production and Rural Development) 2019
Resource Use & Conflict	Commercial Fishing & Boating	7.2	Commercial fishing in estuaries (prawn trawl etc)	✓	✓	✓		✓		✓	Almost Certain	Moderate	Moderate	Moderate	Moderate	Moderate	Social and Economic Evaluation of NSW Coastal Professional Wild-Catch Fisheries SEPP (Primary Production and Rural Development) 2019
Resource Use & Conflict	Commercial Fishing & Boating	7.3	Aquaculture - Oysters	✓		✓	✓	✓		✓	Almost Certain	Minor	Low	Low	Low	Low	NSW Oyster Industry Sustainable Aquaculture Strategy 2016 SEPP (Primary Production and Rural Development) 2019
Resource Use & Conflict	Commercial Fishing & Boating	7.4	Commercial boating - small commercial vessels & charters activities etc	✓		✓	✓	✓			Almost Certain	Moderate	Moderate	Moderate	High	High	NSW Regional Boating Plan for Hawkesbury River, Pittwater and Brisbane Water Region 2015
Resource Use & Conflict	Recreation & Tourism	8.1	Recreational fishing (boat and shore based)	✓	✓	✓	✓	✓			Almost Certain	Minor	Low	Low	Moderate	Moderate	NSW Regional Boating Plan for Hawkesbury River, Pittwater and Brisbane Water Region 2015
Resource Use & Conflict	Recreation & Tourism	8.2	Recreational boating	✓	✓	✓	✓	✓		✓	Almost Certain	Moderate	Moderate	Moderate	High	High	Upper Hawkesbury River Bank Erosion, Foreshore Structure and Weed Mapping, 2013;
Resource Use & Conflict	Recreation & Tourism	8.3	Passive recreational use	✓	✓	✓	✓	✓	✓	✓	Almost Certain	Insignificant	Minimal	Minimal	Minimal	Minimal	Pittwater Public Space and Recreation Strategy 2014 Hornsby Shire Council Unstructured Recreation Strategy Hawkesbury Open Space Strategy Hills Shire Council Recreation Strategy;
Resource Use & Conflict	Recreation & Tourism	8.4	Coastal infrastructure, marina expansion, modifications, upgrades and associated dredging.	✓	✓	✓	✓	✓	✓	✓	Almost Certain	Moderate	Moderate	Moderate	Moderate	Moderate	SEPP (Coastal Management) 2018; Brisbane Water Users Management Pan referenced in workshop table, can't find online or in onedrive.
Resource Use & Conflict	Recreation & Tourism	8.5	Anti-social behaviour and unsafe practices	✓					✓	✓	Almost Certain	Moderate	Moderate	Moderate	Moderate	Moderate	RMS Maritime Safety Plan 2017–2021 NSW Regional Boating Plan for Hawkesbury River, Pittwater and Brisbane Water Region 2015
Resource Use & Conflict	Access & Availability	9.1	Overcrowding / congestion of waterways and user group conflict	✓		✓		✓		✓	Almost Certain	Moderate	Moderate	Moderate	High	High	Brisbane Water Users Management Plan RMS Maritime Safety Plan 2017–2021
Resource Use & Conflict	Access & Availability	9.2	Overcrowding / congestion of foreshore/beaches and user group conflict	✓					✓	✓	Almost Certain	Moderate	Moderate	Moderate	High	High	NSW Maritime Infrastructure Plan 2019-2024 Pittwater Public Space and Recreation Strategy 2014 Hornsby Shire Council Unstructured Recreation Strategy Hawkesbury Open Space Strategy
Resource Use & Conflict	Access & Availability	9.3	Limited or lack of foreshore and waterway access	✓	✓	✓	✓	✓	✓	✓	Almost Certain	Moderate	Moderate	Moderate	High	High	NSW Maritime Infrastructure Plan 2019-2024 Pittwater Public Space and Recreation Strategy 2014 Hornsby Shire Council Unstructured Recreation Strategy Hawkesbury Open Space Strategy
Resource Use & Conflict	Access & Availability	9.4	Limited or lack of supporting infrastructure (for boating etc)	✓	✓	✓	✓	✓	✓	✓	Almost Certain	Moderate	Moderate	Moderate	High	High	NSW Maritime Infrastructure Plan 2019-2024 Pittwater Public Space and Recreation Strategy 2014 Hornsby Shire Council Unstructured Recreation Strategy Hawkesbury Open Space Strategy
Resource Use & Conflict	Access & Availability	9.5	Limited or lack of disability access							✓	Almost Certain	Moderate	Moderate	Moderate	Low	Minimal	NSW Maritime Infrastructure Plan 2019-2024 Pittwater Public Space and Recreation Strategy 2014 Hornsby Shire Council Unstructured Recreation Strategy Hawkesbury Open Space Strategy
Public Health & Safety	Public Health & Safety	10.1	Water pollution/contamination affecting human health and safety	✓	✓	✓	✓	✓		✓	Almost Certain	Major	High	High	High	High	Guidelines for Managing Risks in Recreational Water, NHMRC, 2008 NSW Natural Resources MER Estuary Ecosystem Health Program Hornsby Council Water Quality Monitoring Program
Public Health & Safety	Public Health & Safety	10.2	Seafood contamination	✓	✓	✓				✓	Almost Certain	Major	High	High	High	High	Guidelines for Managing Risks in Recreational Water, NHMRC, 2008 NSW Natural Resources MER Estuary Ecosystem Health Program
Public Health & Safety	Public Health & Safety	10.3	Drinking water contamination							✓	Unlikely	Moderate	Minimal	Minimal	Minimal	Minimal	Sydney Water Drinking Water Management Manual NSW Health Drinking Water Monitoring Program Australian Drinking Water Guidelines
Public Health & Safety	Public Health & Safety	10.4	Coastal hazards (rip currents, hazardous surf conditions, coastal erosion, wave overtopping)						✓	✓	Almost Certain	Moderate	Moderate	Moderate	Moderate	Moderate	IPART Auditing Umina Beach SLSC

Threat	Stressor Category	ID	Stressor	Management Plans & Strategies to Address Threat							Present Day Residual Risk			Future Risk			Comments and Other Management Plans, Strategies and Programs to Adress Threat
				MEMS	UH CZMP	LH EMP	BW CZMP	PITT EMP	GB CZMP	Other↓	Likelihood	Conseq.	Present Risk	20 yr Risk	50 yr Risk	100 yr Risk	
Public Health & Safety	Public Health & Safety	10.5	Public safety risk from aging and/or degraded coastal/estuary infrastructure							✓	Likely	Major	High	High	High	High	NSW Maritime Infrastructure Plan 2019-2024 Local Council Asset Management Plans
Public Health & Safety	Public Health & Safety	10.6	Wildlife interactions (sharks attacks etc)	✓							Possible	Major	Moderate	Moderate	Moderate	Moderate	NSW Shark Management Strategy & SharkSmart Program
Planning & Governance	Governance	11.1	Lack of adequate coordination between estuary councils, catchment councils and state government agencies		✓	✓				✓	Likely	Major	High	High	High	High	NSW Coastal Management Manual
Planning & Governance	Governance	11.2	Inadequate, inefficient regulation, or over-regulation (agencies)	✓							Likely	Moderate	Moderate	Moderate	Moderate	Moderate	
Planning & Governance	Governance	11.3	Lack of compliance with regulations (by users) or lack of regulation effort (by agencies)	✓	✓	✓		✓			Almost Certain	Moderate	Moderate	Moderate	Moderate	Moderate	
Planning & Governance	Governance	11.4	Lack of funding for investigation and action implementation		✓	✓	✓	✓	✓	✓	Almost Certain	Major	High	High	High	High	NSW Coast and Estuary Grants Program
Planning & Governance	Governance	11.5	Lack of or ineffective community engagement or participation in governance	✓							Possible	Major	Moderate	Moderate	Moderate	Moderate	
Planning & Governance	Information Gaps	12.1	Incomplete coastal process information (including climate change impacts)	✓							Possible	Major	Moderate	High	High	High	
Planning & Governance	Information Gaps	12.2	Incomplete ecological information (including climate change impacts)	✓		✓	✓	✓			Almost Certain	Moderate	Moderate	High	High	High	
Planning & Governance	Information Gaps	12.3	Inadequate and/or incomplete European and Indigenous Heritage information	✓			✓				Almost Certain	Moderate	Moderate	Moderate	Moderate	Moderate	
Planning & Governance	Information Gaps	12.4	Inadequate social and economic information	✓			✓				Possible	Moderate	Low	Moderate	Moderate	Moderate	

APPENDIX G
KNOWLEDGE GAP ANALYSIS

Threat	ID	Stressor Category	Stressor	FPRA Risk Level (100yr)	Adequacy of Existing Information				
					Upper Hawkesbury	Lower Hawkesbury	Pittwater	Brisbane Water	Broken Bay
Natural Hazards	1.1	Long Term Hazards	Tidal inundation of estuaries (i.e. sunny day flooding)	High	Low	Moderate	High	Moderate	N/A
Natural Hazards	1.2	Long Term Hazards	Estuary foreshore erosion and bank erosion	High	Moderate	Moderate	Moderate	High	N/A
Natural Hazards	1.3	Long Term Hazards	Long-term coastal shoreline recession	High	N/A	N/A	N/A	N/A	Moderate
Natural Hazards	1.4	Long Term Hazards	Estuary entrance instability	Low	N/A	N/A	High	N/A	Moderate
Natural Hazards	1.5	Long Term Hazards	Cliff and slope instability	Moderate	Low	Low	Low	Low	Moderate
Natural Hazards	2.1	Event Based Hazards	Coastal storm impacts - erosion	High	N/A	N/A	Low	High	Moderate
Natural Hazards	2.2	Event Based Hazards	Coastal storm impacts - inundation	High	Low	Moderate	High	Moderate	Moderate
Natural Hazards	2.3	Event Based Hazards	Combined coastal and catchment flooding	High	Moderate	Moderate	Moderate	Moderate	Moderate
Natural Hazards	2.4	Event Based Hazards	Bushfire	High	Moderate	Moderate	Moderate	Moderate	Moderate
Natural Hazards	2.5	Event Based Hazards	Drought	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Natural Hazards	2.6	Event Based Hazards	Tsunami	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Natural Hazards	3.1	Climate Change Impacts	Altered ocean currents & nutrient inputs	Moderate	Low	Low	Low	Low	Low
Natural Hazards	3.2	Climate Change Impacts	Ocean temperature increase	High	Moderate	Moderate	Moderate	Moderate	Moderate
Natural Hazards	3.3	Climate Change Impacts	Ocean acidification	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Natural Hazards	3.4	Climate Change Impacts	Altered storm frequency & severity	High	Low	Low	Low	Low	Low
Natural Hazards	3.5	Climate Change Impacts	Altered hydrological regimes	High	Low	Low	Low	Low	Low
Natural Hazards	3.6	Climate Change Impacts	Sea Level Rise (SLR)	High	Low	Moderate	High	Moderate	Moderate
Natural Hazards	3.7	Climate Change Impacts	Long term shoreline recession due to SLR	High	N/A	N/A	Low	High	Moderate
Natural Hazards	3.8	Climate Change Impacts	Altered salinity levels / profile	Moderate	Low	Low	Low	Low	Low
Natural Hazards	3.9	Climate Change Impacts	Habitat migration & squeeze	High	Low	Low	Low	Low	Low
Land Use Intensification & Environmental Impacts	4.1	Water pollution and sediment contamination	Urban stormwater discharge	High	Moderate	Moderate	Moderate	Moderate	Moderate
Land Use Intensification & Environmental Impacts	4.2	Water pollution and sediment contamination	Agricultural runoff	High	Moderate	Moderate	Moderate	Moderate	Moderate
Land Use Intensification & Environmental Impacts	4.3	Water pollution and sediment contamination	Industrial discharges	High	Moderate	Moderate	Moderate	Moderate	Moderate
Land Use Intensification & Environmental Impacts	4.4	Water pollution and sediment contamination	Sewage effluent & septic runoff	High	Moderate	Moderate	Moderate	Moderate	Moderate
Land Use Intensification & Environmental Impacts	4.5	Water pollution and sediment contamination	Sediment contamination / pollution (ASS)	High	Moderate	Moderate	Moderate	Moderate	Moderate

Threat	ID	Stressor Category	Stressor	FPRA Risk Level (100yr)	Adequacy of Existing Information				
					Upper Hawkesbury	Lower Hawkesbury	Pittwater	Brisbane Water	Broken Bay
Land Use Intensification & Environmental Impacts	4.6	Water pollution and sediment contamination	Disturbance of contaminated sediment on seabed (e.g. dredging) and in terrestrial areas	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Land Use Intensification & Environmental Impacts	5.1	Habitat Clearing / Disturbance	Foreshore / urban development	High	Moderate	Moderate	Moderate	Moderate	Moderate
Land Use Intensification & Environmental Impacts	5.2	Habitat Clearing / Disturbance	Stock related damage of riparian and marine vegetation	High	Moderate	Moderate	N/A	Moderate	N/A
Land Use Intensification & Environmental Impacts	5.3	Habitat Clearing / Disturbance	Clearing / disturbance of riparian and aquatic habitat including wetland drainage	High	Moderate	Moderate	Moderate	Moderate	Moderate
Land Use Intensification & Environmental Impacts	5.4	Habitat Clearing / Disturbance	Clearing / disturbance of littoral rainforest habitat	Low	N/A	N/A	Moderate	N/A	N/A
Land Use Intensification & Environmental Impacts	5.5	Habitat Clearing / Disturbance	Clearing / disturbance of terrestrial habitat	Moderate	Moderate	Moderate	Moderate	Moderate	High
Land Use Intensification & Environmental Impacts	5.6	Habitat Clearing / Disturbance	Introduction of invasive fauna pest species (e.g. carp, foxes, etc) and diseases (POMS)	High	Moderate	Moderate	Moderate	Moderate	Moderate
Land Use Intensification & Environmental Impacts	5.7	Habitat Clearing / Disturbance	Introduction of invasive flora pest species (e.g. aquatic weeds) and diseases	High	Moderate	Moderate	Moderate	Moderate	Moderate
Land Use Intensification & Environmental Impacts	6.1	Hydrologic Modifications	Increasing groundwater extraction / use	Moderate	Moderate	Low	Low	Low	Low
Land Use Intensification & Environmental Impacts	6.2	Hydrologic Modifications	Modified freshwater flows (in estuaries)	High	Moderate	Moderate	Moderate	Moderate	N/A
Land Use Intensification & Environmental Impacts	6.3	Hydrologic Modifications	Sedimentation & infilling channels and changing flows	High	Moderate	Moderate	Moderate	Moderate	N/A
Land Use Intensification & Environmental Impacts	6.4	Hydrologic Modifications	Navigation & entrance management and modification	Moderate	Moderate	Moderate	Moderate	High	Moderate
Resource Use & Conflict	7.1	Commercial Fishing & Boating	Commercial fishing in coastal waters	Moderate	N/A	N/A	N/A	N/A	Low
Resource Use & Conflict	7.2	Commercial Fishing & Boating	Commercial fishing in estuaries (prawn trawl etc)	Moderate	Moderate	Moderate	Moderate	Moderate	N/A
Resource Use & Conflict	7.3	Commercial Fishing & Boating	Aquaculture - Oysters	Low	N/A	Moderate	N/A	Moderate	N/A
Resource Use & Conflict	7.4	Commercial Fishing & Boating	Commercial boating - small commercial vessels & charters activities etc	High	Moderate	Moderate	Moderate	Moderate	Moderate
Resource Use & Conflict	8.1	Recreation & Tourism	Recreational fishing (boat and shore based)	Moderate	Low	Low	Low	Low	Low
Resource Use & Conflict	8.2	Recreation & Tourism	Recreational boating	High	Low	Low	Moderate	Moderate	Low
Resource Use & Conflict	8.3	Recreation & Tourism	Passive recreational use	Minimal	Moderate	Moderate	Moderate	Moderate	Moderate
Resource Use & Conflict	8.4	Recreation & Tourism	Coastal infrastructure, marina expansion, modifications, upgrades and associated dredging.	Moderate	Moderate	Moderate	Moderate	Moderate	High
Resource Use & Conflict	8.5	Recreation & Tourism	Anti-social behaviour and unsafe practices	Moderate	Low	Low	Low	Low	Low
Resource Use & Conflict	9.1	Access & Availability	Overcrowding / congestion of waterways and user group conflict	High	Moderate	Moderate	Moderate	Moderate	Moderate
Resource Use & Conflict	9.2	Access & Availability	Overcrowding / congestion of foreshore/beaches and user group conflict	High	Moderate	Moderate	Moderate	Moderate	High
Resource Use & Conflict	9.3	Access & Availability	Limited or lack of foreshore and waterway access	High	High	Moderate	High	High	High
Resource Use & Conflict	9.4	Access & Availability	Limited or lack of supporting infrastructure (for boating etc)	High	Moderate	Moderate	Moderate	Moderate	Moderate

Threat	ID	Stressor Category	Stressor	FPRA Risk Level (100yr)	Adequacy of Existing Information				
					Upper Hawkesbury	Lower Hawkesbury	Pittwater	Brisbane Water	Broken Bay
Resource Use & Conflict	9.5	Access & Availability	Limited or lack of disability access	Minimal	Low	Low	Low	Low	Low
Public Health & Safety	10.1	Public Health & Safety	Water pollution/contamination affecting human health and safety	High	High	High	High	High	High
Public Health & Safety	10.2	Public Health & Safety	Seafood contamination	High	Moderate	Moderate	Moderate	Moderate	N/A
Public Health & Safety	10.3	Public Health & Safety	Drinking water contamination	Minimal	Moderate	N/A	N/A	N/A	N/A
Public Health & Safety	10.4	Public Health & Safety	Coastal hazards (rip currents, hazardous surf conditions, coastal erosion, wave overtopping)	Moderate	N/A	N/A	High	N/A	High
Public Health & Safety	10.5	Public Health & Safety	Public safety risk from aging and/or degraded coastal/estuary infrastructure	High	Moderate	Moderate	Moderate	Moderate	Moderate
Public Health & Safety	10.6	Public Health & Safety	Wildlife interactions (sharks attacks etc)	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

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