Lake Illawarra
Coastal Management Program 2020 - 2030

September 2020

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Shellharbour
CITY COUNCIL

Lake Illawarra Coastal Management Program (2020-2030)

Prepared for:	Wollongong City Council and Shellharbour City Council
Prepared by:	BMT Commercial Australia Pty Ltd

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Synopsis: **This Coastal Management Program outlines implementation details for recommended actions for managing Lake Illawarra over current and future timeframes.**

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WCC and SCC	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	
BMT File	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF		
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Acknowledgement to Country

Wollongong City and Shellharbour City Councils would like to show their respect and acknowledge the traditional owners of the Land, of Elders past and present, and extend that respect to other Aboriginal and Torres Strait Islander people.

Acknowledgement

The preparation of the CMP was overseen by a Project Management Team (PMT) consisting of Kristy Blackburn (Chair) (WCC and SCC), Philomena Gangaiya (WCC), Andrew Lee (SCC) and Danny Wiecek (DPIE - Coasts & Estuaries). Past PMT members are Tuesday Heather (SCC) and Andrew Williams (SCC/DPIE- Coasts & Estuaries). The PMT was supported by staff across Wollongong and Shellharbour Councils, in particular Jessica Faustini (WCC) and members of the Lake Illawarra Estuary Management Committee (LIEMC).

Glossary of Terms

Bacteriological	The science and study of bacteria (single-celled microorganisms which can live as independent organisms or, dependently, as parasites).
Biodiversity	The variety of wildlife (both plants and animals) and habitats.
Brackish water	Water with higher salinity than fresh water and lower than seawater.
Breakwater(s)	A man-made structure built offshore to protect coastal areas such as harbours, anchorage etc. from offshore waves.
Climate change	The long-term change (decades or longer) in pattern of weather, and related changes in oceans, sea level, land surfaces and ice sheets.
Contaminant	Substances or groups of substances that are toxic, likely to bio-accumulate and/or give cause for concern.
Dredging	An underwater excavation activity intended to remove sediments and debris. Often used to keep navigable pathways within waterways.
Ebb tide delta	Deposit of marine sediment (usually sand) at the seaward outlet of a tidal creek by ebbing (outgoing) tidal currents.
Ecosystem	A community of living organisms and the surrounding nonliving environment interacting as a system.
Entrance management	Includes artificial opening of entrances, managing the configuration, height or location of the beach to enable entrance opening at a level lower than the natural range.
Entrance training	Deployment of man-made structures designed to constrain river discharges to a desired location.
Erosion	The removal of land by natural forces such as waves, tidal currents and / or littoral currents.
Estuarine macrophytes	Vegetation that can grow emergent, submerged or floating within the water of estuarine environments e.g. saltmarsh, mangroves and seagrass.
Estuary	The section of a river affected by tidal activity where fresh water from the river mixes with salt water from the ocean.
Flood tide delta	Deposit of marine sediment (usually sand) within a coastal embayment that has formed at the landward side of a tidal inlet by rising (or flood) tidal currents.
Foreshore	The section of the shore between the low and high tidal limits.
Geomorphology	A branch of physical geography encompassing the formation of the earth's surface, distribution of land, water etc.
Groundwater	Water that is located beneath the earth's surface accumulated from rain, rivers and marine water that penetrates the ground through soils and rocks where it is then stored.
Inundation (estuarine)	Rising waters caused by a combination of catchment flood waters (from rainfall) and oceanic waters (from tides and high sea levels that occur during storms).
Littoral current	A current flowing parallel to and near the shore, usually generated by breaking waves at the shoreline. Also known as longshore currents.
Littoral transport	Transportation of non-cohesive sediments (usually sand) along the shore by littoral or longshore currents. Also termed longshore sediment transport.

Marine debris	Solid man-made material which is disposed of directly or indirectly into the marine environment.
Marine pest	Introduced (or non-native) plant, animal and other kingdoms that have (or could have) a detrimental impact on the marine environment.
Midden	Aboriginal place of significance where debris from eating shellfish and other food has accumulated over time. Often found on headlands, beaches and dunes, around estuaries, swamps and along the banks of rivers, creeks and lakes.
Native Title	Native Title or native title rights and interests means the communal, group or individual rights and interests of Aboriginal peoples or Torres Strait Islanders in relation to land or waters, where the rights and interests are possessed under the traditional laws and customs observed by the Aboriginal peoples or Torres Strait Islanders, and the Aboriginal peoples or Torres Strait Islanders, by those laws and customs, have a connection with the land or waters; and the rights and interests are recognised by the common law of Australia (s. 223(1) Native Title Act 1993 (Cth)).
Ocean waves	Waves occurring in the ocean that have been generated from wind blowing over the ocean surface over long distances (known as the fetch). Swell or incident waves on the coast typically have a wave period of 8 to 10 seconds, with large storm waves having periods of 12 seconds or greater.
Physico-chemical	Relating to physics and chemistry, or physical chemistry
Wind waves	While most waves are generated by wind, the term “wind waves” is associated with small, short period (3-5 second) waves that are generated locally within a small fetch. Wind waves can be generated on smaller water bodies such as lakes, lagoons, or tidal inlets.
Riparian vegetation	Vegetation located along the banks of a body of water, usually rivers.
Scour	Localised loss of soil often present around a foundation element.
Sea level rise	A long-term increase in mean sea level, usually associated with climate change and increase in temperature in particular.
Sedimentation	The settling of particles (e.g. sand or mud) out of the water column onto the bed of a waterbody.
Sediment cores	A cylindrical sample of soil for tests and examination. Sediment cores are retrieved by sampling soil deposits using a long narrow metal tube.
Siltation	The process by which water becomes dirty and/or polluted as a result of fine mineral particles being suspended in the water.
Stakeholders	Persons or organisations with an interest or concern in a given matter.
Surface water	Natural water sources found on the earth’s surface such as rivers, wetlands, oceans and lakes.
Terrestrial pests	Introduced (or non-native) plant, animal and other kingdoms that have (or could have) a detrimental impact on the terrestrial environment.
Tidal currents	Currents caused by the incoming (flood) or outgoing (ebb) tide (see Tide). Tidal currents are typically the main current within estuaries, particularly in the entrance area where tidal currents transport marine sediments (sand).
Tide	The periodic rise and fall of the water of oceans, seas, bays, etc., caused mainly by the gravitational interactions between the Earth, Moon and Sun.
Tributary	A stream or river that flows into a larger stream or lake.
Wetland	Areas of land that are partly saturated by water, including marshes, swamps etc.

Executive Summary

Lake Illawarra and its catchment span both the Wollongong and Shellharbour Local Government Areas. The Lake has a complex management history. Prior to 1988 the Lake was managed by WCC and SCC and other agencies, however in response to concerns over the declining health and environmental condition of the Lake, the Lake Illawarra Authority (LIA) was formed by the NSW Government to take over management of the Lake. The LIA undertook numerous foreshore rehabilitation projects, algal harvesting, bank stabilisation and the construction of several gross pollutant traps and artificial wetlands around the Lake. Most notably the LIA constructed the entrance breakwaters to keep the Lake continuously open to the ocean. The LIA worked collaboratively with WCC and SCC in delivering environmental and infrastructure initiatives until 2014 when it was disbanded. Wollongong City Council (WCC) and Shellharbour City Council (SCC), with support from State Agencies such as the Department of Planning, Industry and Environment (DPIE) – Environment and Energy Services, and DPIE – Crown Lands have resumed management of the Lake since 2014.

Lake Illawarra is a highly valued natural resource within the Illawarra region, and is immensely valuable from an ecological, social, cultural and economic perspective. The Lake provides habitat for fringing protected communities such as coastal saltmarsh, swamp oak floodplain forest, littoral rainforest and extensive areas of seagrass. Saltmarsh, seagrass and mangroves provide essential habitat, food supply and nutrient cycling. This in turn supports fish assemblages and wildlife, contributes to good water quality and provides scenic qualities. It is highly valued and heavily utilised by the community, particularly for recreation such as fishing, sailboarding, boating, swimming, kayaking, and picnics, cycling and walking along the foreshores. The Lake also contains areas of cultural significance from both the long history of Aboriginal use of the estuary as well as non-indigenous development and use of the Lake over the last 100 years. Economically, the Lake supports tourism industries relating to its recreational opportunities as well as the commercial fishing industry.

Balancing the existing modified environment with the community's aspirations for use and enjoyment of the Lake is extremely complex given the many threats and challenges facing the Lake. These threats and challenges include water pollution, increasing residential development pressures, past and present industrial uses in the catchment, major geomorphic, hydrodynamic and ecological changes to the Lake resulting from the entrance breakwater construction, loss of habitat, climate change, degraded infrastructure, as well as the political, financial, resourcing, and social challenges that spring from management across multiple agencies.

The Lake Illawarra Coastal Management Program facilitates the coordinated and strategic management of the Lake by all responsible stakeholders. The CMP aims to provide the strategic direction and specific actions to address threats to the Lake to maintain and improve its ecological, social and economic value with the view to achieve ecological sustainability for Lake Illawarra over the long term. It is a program of physical works, monitoring and investigations, and planning and education initiatives that target the threats to the Lake's ecological and cultural values and includes actions directly aimed at improving recreational opportunities for the public.

This CMP outlines nine management strategies chosen to address each threat, or group of threats and gives effect to specific actions to mitigate the threats and challenges identified for the Lake. These actions are to be implemented over the next 5 to 10 years and were prioritised based upon the level of risk. The CMP includes 39 actions selected for implementation under the following nine strategies:

- Improve Water Quality (9 actions),

- Improve Planning & Management Arrangements for the Lake (4 actions),
- Manage Changes to the Entrance Channel (5 actions),
- Protect and Rehabilitate Riparian and Estuarine Vegetation (5 actions),
- Maintain and Improve Recreation and Amenity (6 actions),
- Protect and Promote Cultural Heritage (1 action),
- Manage Foreshore and Bank Erosion (3 actions),
- Prepare for Inundation Risks (5 actions); and
- Protect and Manage Key Fauna (1 action).

Of the 39 management actions WCC is listed as responsible for 37 and supporting for 1, and SCC is responsible for 38 actions and supporting for 1. Management actions may utilise a variety of implementation mechanisms that can act at different levels or on different aspects of the problem. These include planning and development controls, physical works, rehabilitation works, education and awareness programs, and monitoring programs, data collection and assessments.

The CMP is an operational document for this community to take action to manage, preserve, improve, promote and rehabilitate our Lake. Preserving and restoring the water quality and environmental habitats of Lake Illawarra is vital to the culture and economy of the local community, with benefits flowing on to the entire state of NSW.

Delivery of the Lake Illawarra CMP is estimated to cost $36,340,000 over 10 years.. Based upon the timeframes for actions and estimated costings, $6,933,000 is required in Year 1 to implement specified actions. A forecast $14,087,000 is estimated across Year 2 to 5 (inclusive), with a final $14,820,000 required over Years 6 to 10 for the plan. WCC and SCC, as well as state agencies and other stakeholders are responsible for funding and/or implementing the actions. The existing budgets of the Council may fund some or part of the actions, particularly in the CMP's first year until grant funding applications can be made. The Lake Illawarra CMP strategies and actions align with the goals, objectives and strategies of the Wollongong and Shellharbour Community Strategic Plans. It should be noted that several actions scheduled for year one are already in the process of being implemented.

Once the program is certified, WCC and SCC will be responsible for facilitating through budgetary processes the implementation of the plan, using both specific staff resources and using existing elements of the IP&R Framework of both councils to undertake, track and measure the success of actions in the CMP.

The Lake Illawarra CMP requires evaluation and reporting regarding the success of its implementation, and the success of actions in reducing the threats and maintaining the values of Lake Illawarra. This CMP is to be the first of many iterations of a coastal program of works to manage Lake Illawarra, such plans, and the studies that underpin them, should be revised at least every 10 years.

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1 Introduction and Strategic Context

1.1 Purpose of the Lake Illawarra Coastal Management Program

Wollongong City and Shellharbour City Councils (WCC and SCC) with the assistance of the NSW Department of Planning, Industry and Environment (DPIE) resolved to prepare this Lake Illawarra Coastal Management Program (CMP), to provide the strategic direction and specific actions to address the threats to the Lake and to maintain the ecological, social and economic values of the Lake. The overall intent of the CMP is to work towards achieving ecological sustainability for Lake Illawarra over the long term.

The Lake Illawarra CMP has been prepared in accordance with the mandatory requirements for CMPs specified in the *Coastal Management Act 2016* (the CM Act) and accompanying NSW Coastal Management Manual (OEH, 2018).

This CMP outlines the strategic aims for managing the Lake and identifies specific actions to mitigate the threats and issues identified for the Lake that are to be implemented over the next 5 to 10 years. Clear details for how actions will be implemented, funded, monitored, and reviewed are given in this CMP. The CMP is an operational document for the community and government to take action to manage, preserve, improve, promote and rehabilitate our Lake.

1.2 Introduction to Lake Illawarra

Lake Illawarra (the Lake) is a large estuary system located approximately 80km south of Sydney and 10km south of Wollongong, shown in Figure 1-1 and Figure 1-2. The Lake catchment covers an approximate area of 240 km^2, with a lake surface area of around 35 km^2 and an average depth of 2.1 m (OEH, 2012). The Lake is a highly modified wave dominated barrier estuary with a shallow flat-bottomed bed.

The Lake and its catchment span both the Wollongong and Shellharbour Local Government Areas (LGAs) (refer to Figure 1-1). Predominantly the Lake is co-managed by Wollongong City Council (WCC) and Shellharbour City Council (SCC), with support from State agencies such as DPIE – Environment, Energy and Science: Coasts and Estuaries (DPIE - Coasts & Estuaries), and DPIE – Crown Lands. Most notably, DPIE – Crown Lands now manages the Lake Illawarra entrance management works.

The Lake is a highly valued natural resource within the Illawarra region, and is immensely valuable from an ecological, social and economic perspective. Lake Illawarra is considered one of the more complex estuary systems on the NSW south coast in terms of balancing the existing modified environment with the community's aspirations for use and enjoyment of the Lake, past and present industrial uses in the catchment, and increasing residential development pressures. Management of the Lake across the two councils and various agencies further increases the political, financial, resourcing, social and other challenges of managing this important Lake.

In its previously natural condition, the entrance was typically narrow, shoaled and intermittently closed, opening in response to elevated water levels following rainfall events. Between 2000 and 2007, in conjunction with channel dredging and the implementation of training walls, the entrance breakwaters were constructed to keep the Lake continuously open to the ocean. The entrance

breakwaters have resulted in major geomorphic, hydrodynamic and ecological changes to the Lake. Lake Illawarra supports numerous protected species and endangered ecological communities, including a number of migratory bird species. The gently sloping foreshores provide habitat for extensive areas of coastal saltmarsh, while the shallow subtidal areas support extensive seagrass.

The Lake is also highly valued and heavily utilised by the community, particularly for recreation such as fishing, sailboarding, boating, swimming, kayaking, and picnics, cycling and walking along the foreshores. Economically, the Lake supports tourism industries relating to its recreational opportunities. There is a locally significant commercial fishing effort in Lake Illawarra with the overall catch now dominated by sea mullet, blue swimmer crab, dusky flathead and, up until recently, school prawns.

The Lake contains areas of cultural significance from both the long history of Aboriginal use of the estuary, and non-indigenous development and use of the Lake over the last 100 years. The Lake provided more than just a food source for the Aboriginal people of the Illawarra region. The Traditional occupants of the land of the Illawarra region, the Yuin people not only utilised the natural environment for survival and protection, but also had and still have a strong spiritual connection to the Lake and the surrounding land. The significance of this site to the Yuin people stretches for thousands of years into the past, and its importance to the Aboriginal community continues today.

The pressures on the natural resources of Lake Illawarra are significant and include both natural coastal hazards as well as those brought about by human use of the foreshore and catchment. Population growth and growing residential development needs, tourism and recreational activities as well as climate change impacts all place pressure on the Lake.

1.3 Area Covered by this CMP

This CMP covers the entire Lake Illawarra estuary and catchment as it affects the estuary, with a focus on the tidal part of the Lake, as shown in Figure 1-1. That is the CMP focuses on:

- the tributaries to the Lake (including Macquarie Rivulet, Mullet, Brooks, Duck and Horsley Creeks and other smaller creeks) up to and immediately beyond their tidal limit;
- downstream to the entrance channel (including the entrance training works and extending out to the ebb tide delta); and
- all foreshore (and backshore) areas of the Lake.

While the study area has a focus on the tidal part of the Lake, the influence of the wider catchment areas insofar as activities that pose a high threat to the estuary system (see Figure 1-1 and Figure 1-2) are considered. For example, a major threat to the health of the Lake is urban development of the catchment. Therefore, consideration of managing the impacts from this development is critical to this CMP and is why the broader catchment and all tributaries (above the tidal limits) are also included in study area. It should be noted that not all threats across the entire catchment are considered (e.g. weeds in bushland at the back of the catchment), but only those with a more direct and significant consequence on estuary health. The CMP applies only to the Lake Illawarra catchment area that forms part of both the Shellharbour and Wollongong LGAs.

Lake Illawarra is a listed estuary in Schedule 1 to the CM Act. As the estuary extends across two LGAs, it is recommended and indeed preferable that a CMP, which governs the estuary's management, is prepared jointly by both local councils, as is the case for this Lake Illawarra CMP.

1.3.1 Coastal Management Areas in the CMP Area

This CMP is made in relation to that part of the coastal zone shown in Figure 1-3 (reproduced from mapping by DPIE – PA in 2017) and currently encompasses the following three of the four coastal management areas:

- Coastal wetlands and littoral rainforest area;
- Coastal environment area; and
- Coastal use area.

The CMP does not include a coastal vulnerability area as this is not currently mapped, and at this stage, the councils have no intent to map one. Detailed description and the management objectives for each coastal management area as taken from the CM Act are provided in Appendix A.

It should be noted that development for the purpose of environmental works, undertaken by or on behalf of public authorities, on land identified as "coastal wetlands" or "littoral rainforest" within the Coastal Wetlands and Littoral Rainforests Area Map may be carried out without further development consent if they are consistent with this CMP.

1.3.1.1 Coastal Vulnerability Area

While there is not currently mapping of the coastal vulnerability area in NSW under the CM SEPP, including for Lake Illawarra, it is recognised that Lake Illawarra is subject to coastal hazards and that the scope of this CMP also covers managing coastal vulnerability. Lake Illawarra is subject to coastal hazards including foreshore erosion, inundation due to catchment rainfall and/or elevated ocean water levels (also termed coastal inundation), and ongoing changes in mean and tidal water levels due to entrance opening and sea level rise (also termed tidal inundation).

Inundation relating to catchment rainfall coincident with storm event elevated ocean water levels is already managed through the NSW floodplain risk management framework and is therefore not repeated by this CMP. Existing actions in place to manage flooding include the preparation of Flood Studies and Floodplain Risk Management Plans for the Lake (refer Section 1.9) and major tributaries, and clauses in the Local Environmental Plans (LEPs) and planning provisions in the Development Control Plans (DCPs) of Shellharbour and Wollongong LGAs.

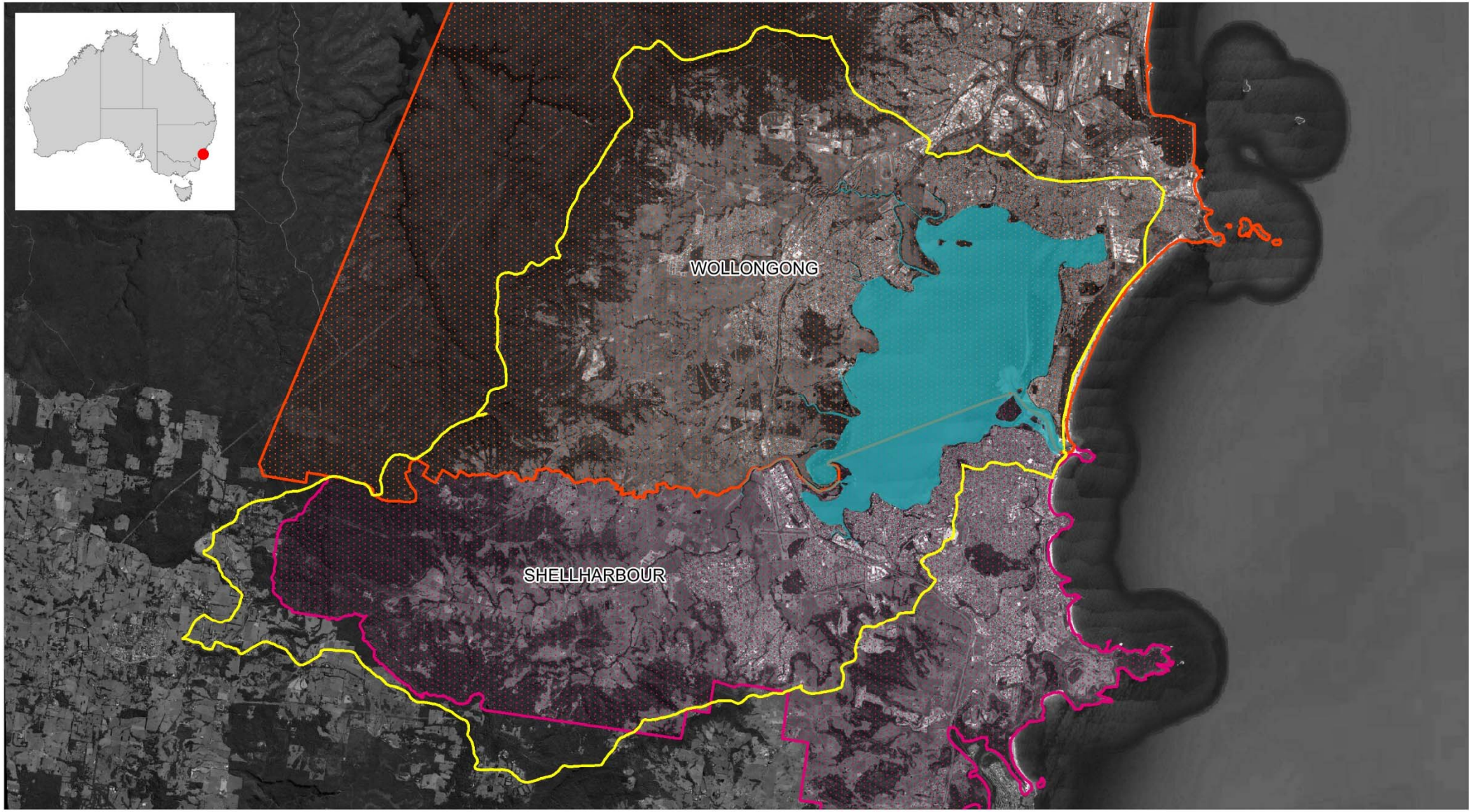
While it is not the intent of this CMP to pursue a planning proposal to adopt a coastal vulnerability area at this time, it is noted that suitable mapping is presently available to do so. This mapping will be used to inform land use planning for the Lake. Cardno (2010, 2012) modelled coastal inundation due to storm event elevated ocean water levels without catchment rainfall at present and at 2050 and 2100 including sea level rise. The inundation mapping provided by Cardno (2012) represents the water level during periodic ocean storm events, which is then applied around the foreshore using a simple water height approximation (or 'bath tub') approach. The Cardno (2012) modelling is discussed and mapping provided in Appendix Section A.1.2.

On behalf of WCC, SCC and DPIE, the University of Wollongong completed mapping of the tidal inundation hazard in Lake Illawarra that is projected to occur due to both the increasing tidal range in the Lake since permanent opening of the entrance, and sea level rise. Kumbier et al (2019) investigated the mean high water spring (MHWS) and high high water solstice spring (HHWSS) tidal water levels at present, 2040, 2070 and 2100. Discussion and model output from the tidal inundation assessment by Kumbier et al (2019) is provided in the *Lake Illawarra Information Synthesis Report* (BMT, 2020a). The tidal inundation modelling was used to assess the risks from tidal inundation and then incorporate risk assessment findings into the threat assessment that supports this CMP, and to develop and augment management actions in this CMP to treat inundation risks. Further details regarding the tidal inundation risk assessment are contained in Appendix C of the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* Report (BMT, 2020b).

As noted above, this CMP also covers managing coastal vulnerability, and Lake Illawarra is subject to a range of coastal hazards including foreshore erosion, coastal inundation and tidal inundation. Actions are included in this CMP to address coastal hazards, including the assessment of coastal hazards for development and future planning, as summarised in Table 1-1 below.

Table 1-1 CMP Actions to address Coastal Hazards and Coastal Vulnerability

Action ID	Action Label / Descriptor	Coastal Hazard(s) Addressed
PM1	Commence integration of key objectives and strategies from the CMP into relevant planning and policy documents of both Councils. This action provides for updates to LEPs, DCPs to manage various coastal hazards.	Foreshore Erosion Coastal Inundation Tidal Inundation
PM4	Establish a Lake Illawarra Asset Management Working Group, which will include: providing a forum for exchange of information relating to inundation risk, particularly for forward planning of asset replacement and renewal in areas at risk of tidal or storm event inundation.	Coastal Inundation Tidal Inundation
EC1	Investigate and Finalise Options to Manage Erosion and Accretion Changes in the Entrance Channel	Foreshore Erosion: Entrance Channel
EC2	Undertake small scale works (e.g. beach scraping, re-shaping etc) to maintain swimming areas.	Foreshore Erosion: Entrance Channel
EC3	Undertake emergency works or small scale no-regrets actions as required to mitigate known risks to property and public safety	Foreshore Erosion: Entrance Channel
EC4	Monitor changes to the entrance channel.	Foreshore Erosion: Entrance Channel
EC5	Monitor and maintain existing entrance channel infrastructure, with any works to be informed by EC1-EC2 and EC4.	Foreshore Erosion: Entrance Channel
EV1	Rehabilitate vegetation and manage public access along foreshores and banks of the Lake, its tidal tributaries, islands and broader low-lying areas.	Foreshore / bank erosion
EV2	Undertake targeted action to control damage to foreshore vegetation, including seagrasses	Foreshore / bank erosion
FB1	Undertake a bank condition assessment and determine and implement erosion control measures	Foreshore / bank erosion
FB2	Implement Environmentally Friendly Seawall Guidelines or similar for new and upgraded foreshore protection works	Foreshore / bank erosion
IR1	Update Asset Management Plans for all publicly owned and managed assets to clearly identify asset at risk from inundation over future timeframes, including tidal inundation	Coastal Inundation Tidal Inundation
IR2	Prepare a whole of Lake Foreshore Adaptation Plan for public (community and environmental) lands	Coastal Inundation Tidal Inundation
IR3	Incorporate tidal inundation mapping into strategic land use planning documents	Tidal Inundation
IR4	Undertake water level and condition monitoring for all lake inundation events	Coastal Inundation Tidal Inundation
IR5	Investigate novel solutions to manage inundation risks to assets such as stormwater, sewer, and water; cycleways, roads and bridges, etc	Coastal Inundation Tidal Inundation



LEGEND

- Wollongong LGA Boundary
- Shellharbour LGA Boundary
- Lake Illawarra Catchment/CMP Area
- Tidal limit

Title:

Locality Map
Lake Illawarra CMP Study and Catchment Areas

Figure: **1-1**

Rev: **B**

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Approx. Scale

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Title:

Lake Illawarra and Waterways

Figure: 1-2

Rev: B

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

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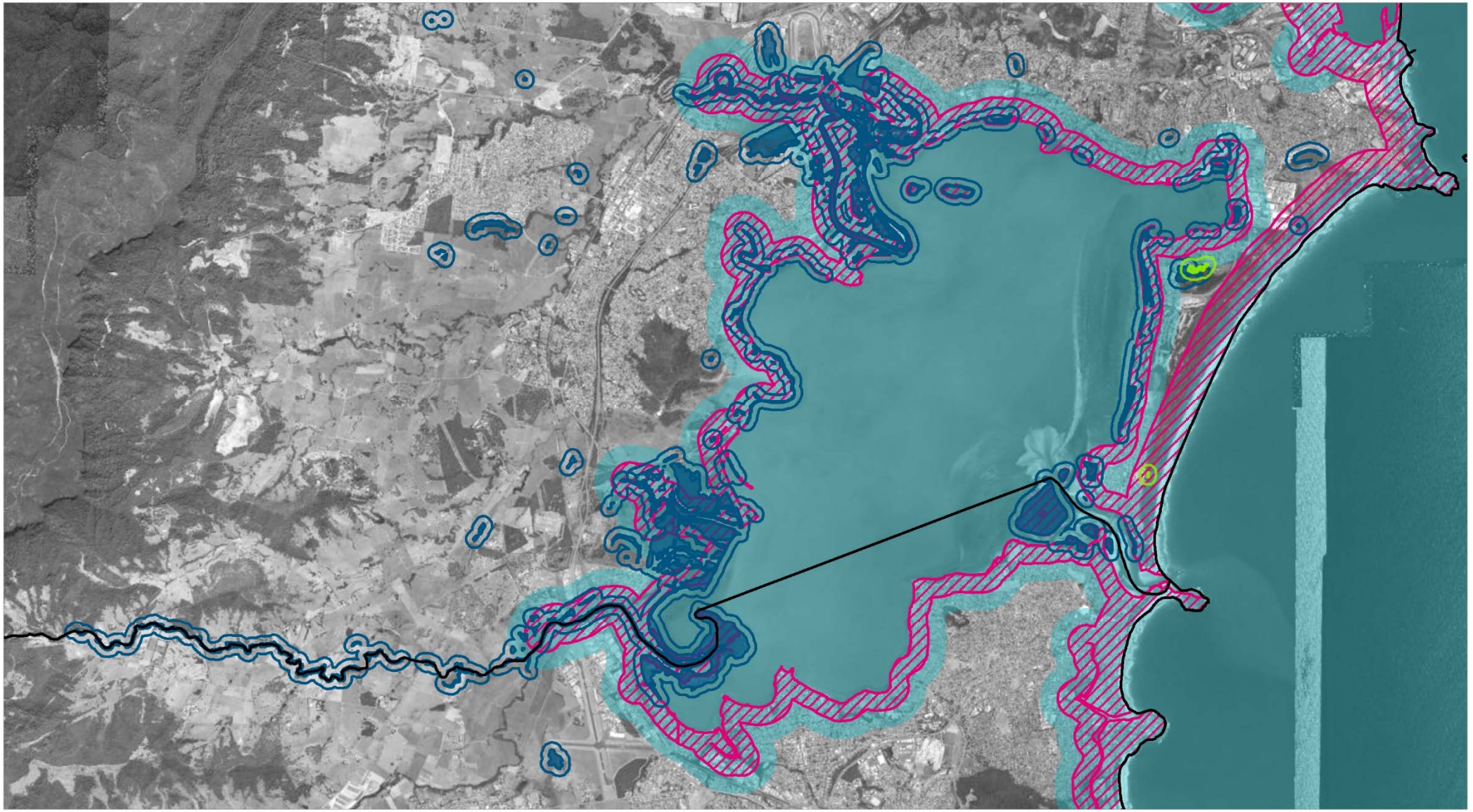

LEGEND

- Littoral Rainforests
- Proximity Area for Littoral Rainforests
- Coastal Wetlands
- Proximity Area for Coastal Wetlands
- Coastal Environmental Area
- Coastal Use Area
- LGA Boundary

Title:

Coastal Management Areas for Lake Illawarra (excluding Coastal Vulnerability)

Figure: 1-3

Rev: C

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Approx. Scale

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1.4 Who is the CMP for?

While the estuary and its catchment extend over two separate LGAs, the natural processes occurring within the estuary, their associated values, threats and opportunities are largely cross-jurisdictional. The estuary and its catchment are a holistic system and need to be managed as such by all stakeholders responsible for the Lake, and its catchment insofar as it affects the Lake. The CMP is a guiding document for those involved in managing the Lake, and who are variously responsible for implementing the actions in this CMP for the benefit of the community and the environment.

The majority of the actions are the responsibility of WCC and SCC. For WCC and SCC, issues and associated management responses are likely to be similar across both LGAs, meaning that there are significant advantages to managing the estuary in a coordinated and integrated manner. Pooled funds and resources are also likely to be more efficiently used, without the need for duplication. Both councils agreed to collaborate in preparing this CMP with support from DPIE - Coasts & Estuaries, and this CMP aims to provide the judicious management of the Lake and its surrounds into the future.

DPIE - Coasts & Estuaries is also a key stakeholder, having contributed financial and technical support to developing this CMP, and can assist with funding many CMP actions through the NSW Coastal and Estuary Grants Program.

DPIE – Crown Lands is another key stakeholder as, under the Crown Land Management Act 2016, they own and/or manage: submerged Crown land within the Lake waterbody, Crown reserves land on parts of the foreshore and some associated infrastructure; and is either a ‘responsible’ or ‘supporting’ agency for some actions within the plan.

A range of other stakeholders have responsibilities in this plan, ranging from directly implementing actions, to providing financial, technical or other support to this CMP, including: the NSW Marine Estate Management Authority (MEMA), DPIE Regions, Industry, Agriculture and Resources – Fisheries (DPI Fisheries), DPIE – Planning and Assessment (DPIE – PA), Transport for NSW(TfNSW), DPIE – National Parks and Wildlife Service (NPWS), Sydney Water Corporation (Sydney Water), Illawarra Local Aboriginal Land Council (ILALC), as well as developers, tourism operators, recreational fishers, residents, visitors and the broader public.

1.4.1 Land Tenure and Ownership

Between 1988 and 2014, the Lake Illawarra Authority (LIA) had primary responsibility for managing the Lake, including most of its assets, and sections of foreshore and public lands in conjunction with WCC and SCC. Through joint funding arrangements from the State Government and Councils, the LIA delivered significant asset improvements to all foreshore lands around the Lake.

When the LIA was disbanded, LIA land and assets were transferred back to the State Government (various agencies, predominantly DPIE – Crown Lands) and to the local Councils (Wollongong and Shellharbour). The remainder of the Lake foreshore is privately owned and managed. The entrance islands are either managed by WCC or SCC, and Hooka and Gooseberry Islands are managed by NPWS. The change in ownership and management arrangements, from one overarching management body to several, means that a well-considered and supported CMP is vital to achieve effective and coordinated management responses for the Lake. Management Strategy 4.2 “Improve

Planning and Management Arrangements for the Lake" outlines several actions which aim to achieve such coordination.

Each council, as well as DPIE, has responsibilities in relation to native title, Aboriginal Land Claims and the management of Crown Lands under the following pieces of legislation: Native Title Act 1993 (Cth), Native Title (NSW) Act 1994, Crown Land Management Act 2016 and Aboriginal Land Rights Act 1983. The registered Native Title Claim (NC2017/003 South Coast People) covers the entire CMP study area. No determinations regarding the Claim have been made to date. In the event that a CMP activity or works are scheduled to take place on a Crown reserve, advice on compliance under these acts will need to be obtained from a Native Title Manager. It is noted that relevant authorisations and appropriate tenure arrangements may need to be obtained for actions on public land under the Crown Land Management Act 2016.

1.5 Coastal Strategy Statement and Objectives

This CMP sets the long-term strategy for the coordinated management of Lake Illawarra. In particular, the CMP aims to:

- protect and enhance the natural processes and environmental values of Lake Illawarra including natural character, scenic value, biological diversity and ecosystem integrity and resilience,
- support the social and cultural values of the coastal zone and maintain public access, amenity, use and safety,
- encourage and promote plans and strategies to improve the resilience of the Lake to the impacts of an uncertain climate future including impacts of climate change,
- ensure co-ordination of the policies and activities of WCC and SCC and public authorities relating to Lake Illawarra and to facilitate integration, and
- support public participation and greater public awareness, education and understanding of Lake processes and management actions.

1.5.1 Objectives

In accordance with the CM Act, this CMP shall give effect to the management objectives for the four coastal management areas that exist within Lake Illawarra and its catchment. The coastal zone is defined in the CM Act as comprising four coastal management areas. The CM Act provides the definition and objectives for each of the management areas. *The State Environmental Planning Policy (Coastal Management) 2018* (CM SEPP) provides development controls for each of the management areas, and statewide mapping of the areas. The four coastal management areas as defined by the CM Act are, in order of priority:

- coastal wetlands and littoral rainforest area;
- coastal vulnerability area (not yet mapped);
- coastal environment area; and
- coastal use area.

These new definitions of coastal zones have been adopted by the NSW Government to enable targeted management of the diverse environments occurring throughout the coast. The overall aim of this approach is to balance social, economic and environmental interests by promoting a coordinated approach to coastal management (DPE, 2016).

Through the implementation of the actions in this CMP, it is intended that threats to Lake Illawarra will be eliminated, reduced, mitigated or otherwise managed to a tolerable level; and that the values of the Lake will be preserved and enhanced. It is expected that the management objectives identified in the CM Act for the coastal management areas will be achieved by addressing the threats and values identified for Lake Illawarra. The values and threats identified for Lake Illawarra are detailed in Sections 2.3 and 2.4 respectively.

The CM Act states under Part 1, Section 3 "*the objects of this Act are to manage the coastal environment of New South Wales in a manner consistent with the principles of ecologically sustainable development for the social, cultural and economic well-being of the people of the State*". It also sets out 13 objects of the CM Act that must be considered and promoted when preparing a CMP. The 13 objects of the CM Act and the objectives of the four coastal management areas have been incorporated in this CMP, and can be found in the sections outlined in Table 1-2.

Table 1-2 Objects of the CM Act and Objectives of the four Coastal Management Areas and their Consideration within this CMP

CM Act Section 3	Objects of the CM Act	Action section in this CMP
(a)	to protect and enhance natural coastal processes and coastal environmental values including natural character, scenic value, biological diversity and ecosystem integrity and resilience.	4
(b)	to support the social and cultural values of the coastal zone and maintain public access, amenity, use and safety.	4.2, 4.5
(c)	to acknowledge Aboriginal peoples' spiritual, social, customary and economic use of the coastal zone.	4.6
(d)	to recognise the coastal zone as a vital economic zone and to support sustainable coastal economies.	4
(e)	to facilitate ecologically sustainable development in the coastal zone and promote sustainable land use planning decision-making.	4.2, 4.8
(f)	to mitigate current and future risks from coastal hazards, taking into account the effects of climate change.	4.3, 4.7, 4.8
(g)	to recognise that the local and regional scale effects of coastal processes, and the inherently ambulatory and dynamic nature of the shoreline, may result in the loss of coastal land to the sea (including estuaries and other arms of the sea), and to manage coastal use and development accordingly.	4.3, 4.7, 4.8
(h)	to promote integrated and co-ordinated coastal planning, management and reporting.	4
(i)	to encourage and promote plans and strategies to improve the resilience of coastal assets to the impacts of an uncertain climate future including impacts of extreme storm events.	4.8

(j)	to ensure co-ordination of the policies and activities of government and public authorities relating to the coastal zone and to facilitate the proper integration of their management activities.	4.2
(k)	to support public participation in coastal management and planning and greater public awareness, education and understanding of coastal processes and management actions.	4
(l)	to facilitate the identification of land in the coastal zone for acquisition by public or local authorities in order to promote the protection, enhancement, maintenance and restoration of the environment of the coastal zone.	4.5, 4.8
(m)	to support the objects of the *Marine Estate Management Act 2014*.	4
CM Act Section 6(2)	**Management Objectives of the Coastal Wetlands and Littoral Rainforests Area**	**Action section in this CMP**
(a)	to protect coastal wetlands and littoral rainforests in their natural state, including their biological diversity and ecosystem integrity	4.4
(b)	to promote the rehabilitation and restoration of degraded coastal wetlands and littoral rainforests	4.4
(c)	to improve the resilience of coastal wetlands and littoral rainforests to the impacts of climate change, including opportunities for migration	4.4
(d)	to support the social and cultural values of coastal wetlands and littoral rainforests	4.4
(e)	to promote the objectives of State policies and programs for wetlands or littoral rainforest management	4.4
CM Act Section 7(2)	**Management Objectives of the Coastal Vulnerability Area**	**Action section in this CMP**
(a)	to ensure public safety and prevent risks to human life	2, 4.1, 4.8
(b)	to mitigate current and future risk from coastal hazards by taking into account the effects of coastal processes and climate change	2, 4.1, 4.8
(c)	to maintain the presence of beaches, dunes and the natural features of foreshores, taking into account the beach system operating at the relevant place	2, 4.4, 4.5, 4.7
(d)	to maintain public access, amenity and use of beaches and foreshores	2, 4.5
(e)	to encourage land use that reduces exposure to risks from coastal hazards, including through siting, design, construction and operational decisions	2, 4.2
(f)	to adopt coastal management strategies that reduce exposure to coastal hazards: (i) in the first instance and wherever possible, by restoring or enhancing natural defences including coastal dunes, vegetation and wetlands, and if that is not sufficient, by taking other action to reduce exposure to those coastal hazards	2, 4.2, 4.3, 4.4, 4.7, 4.8

(g)	if taking that other action to reduce exposure to coastal hazards: (i) to avoid significant degradation of biological diversity and ecosystem integrity, and (ii) to avoid significant degradation of or disruption to ecological, biophysical, geological and geomorphological coastal processes, and (iii) to avoid significant degradation of or disruption to beach and foreshore amenity and social and cultural values, and (iv) (iv) to avoid adverse impacts on adjoining land, resources or assets, and to provide for the restoration of a beach, or land adjacent to the beach, if any increased erosion of the beach or adjacent land is caused by actions to reduce exposure to coastal hazards	2, 4
(h)	to prioritise actions that support the continued functionality of essential infrastructure during and immediately after a coastal hazard emergency	4
(i)	to improve the resilience of coastal development and communities by improving adaptive capacity and reducing reliance on emergency responses	2, 4.2, 4.3, 4.4, 4.7, 4.8
CM Act Section 8(2)	**Management Objectives of the Coastal Environment Area**	**Action section in this CMP**
(a)	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	4.1, 4.2, 4.4
(b)	to reduce threats to and improve the resilience of coastal waters, estuaries, coastal lakes and coastal lagoons, including in response to climate change	4.1, 4.2, 4.4
(c)	to maintain and improve water quality and estuary health	4.1, 4.2, 4.4
(d)	to support the social and cultural values of coastal waters, estuaries, coastal lakes and coastal lagoons	4.6
(e)	to maintain the presence of beaches, dunes and the natural features of foreshores, taking into account the beach system operating at the relevant place	4.2, 4.3, 4.4
(f)	to maintain and, where practicable, improve public access, amenity and use of beaches, foreshores, headlands and rock platforms	4.5
CM Act Section 9(2)	**Management Objectives of the Coastal Use Area**	**Action section in this CMP**
(a)	to protect and enhance the scenic, social and cultural values of the coast by ensuring that: (i) the type, bulk, scale and size of development is appropriate for the location and natural scenic quality of the coast, and	4

	(ii) adverse impacts of development on cultural and built environment heritage are avoided or mitigated, and (iii) urban design, including water sensitive urban design, is supported and incorporated into development activities, and (iv) (iv) adequate public open space is provided, including for recreational activities and associated infrastructure, and the use of the surf zone is considered	
(b)	to accommodate both urbanised and natural stretches of coastline	4

1.6 Timeframes Covered by this CMP

This CMP has been prepared for a 10-year period from 2020 to 2030. However, the CMP considers a range of timeframes and planning horizons both in completing the risk assessment for known threats to the Lake, and in terms of the management actions to address these threats both now and into the future. For certain threats that we know are likely to change over time, the following future timeframes were considered:

- 2040-2050, where 20 years from present (i.e. 2040) is a regularly applied "short(er)" planning timeframe, and 2050 is and was a commonly applied timeframe for strategic planning purposes;
- 2070-2100+, where 50 years from present (i.e. 2070) is a regularly applied planning timeframe, 2100 is and was a commonly applied timeframe for strategic planning purposes, and consideration of timeframes beyond 2100 is also given because processes such as sea level rise will continue for many hundreds of years regardless of climate change mitigation actions.

Coastal vulnerability assessments such as storm event coastal inundation and tidal inundation were based on deterministic models with set timeframes, specifically:

- Present, 2050 and 2100 timeframes were investigated for coastal inundation modelling for storm events (ocean water levels) by Cardno (2010, 2012); and
- Present, 2040, 2070 and 2100 timeframes were investigated for tidal inundation modelling by University of Wollongong (Kumbier et al, 2019).

The level of risk to built and natural assets due to coastal and tidal inundation have been investigated for existing and future timeframes, and the existing and future risk levels were then used to develop the management actions detailed in this CMP (refer Section 2.4).

In all cases, management actions were developed as a priority for threats considered to be high or very high at the present timeframe, as explained in Section 3. Management actions were also developed for future high and very high threats where the future threat is well accepted and requires planning intervention now in order to adequately manage the future threat. This is particularly the case for climate change related risks. For example, planning to enable migration of species with sea level rise into currently suitable / available land areas needs to commence now to secure these suitable land areas into the future.

1.7 The Coastal Management Process in NSW

In 2016, the NSW Government passed the *Coastal Management Act 2016* (CM Act), which repeals the *Coastal Protection Act 1979*. The Act became operational in April 2018 along with several other components of the NSW Governments new Coastal Management Framework. This framework also includes the State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP), and a Coastal Management Manual (OEH, 2018). The new Coastal Management Framework is outlined in Figure 1-4.

A CMP is a strategic and operational document that may be prepared under the CM Act for managing a part of the coastal zone. As noted in Section 1.5.1, the coastal zone is now defined as comprising four coastal management areas (namely coastal wetlands and littoral rainforest, vulnerability, environment, and use, in order of priority). A CMP must identify the area covered by the program, and what coastal management areas are covered within that area, such as described for Lake Illawarra in Section 1.3.

A CMP must meet the mandatory requirements as set out in the CM Act, and any further requirements specified in the Coastal Management Manual (OEH, 2018).and CM SEPP. The CM Act states that a CMP must:

- identify the coastal management issues affecting the areas to which the program is to apply;
- identify the actions required to address those coastal management issues in an integrated and strategic manner;
- identify how and when those actions are to be implemented, including those to be implemented by local councils under Chapter 13 of the *Local Government Act 1993* (that is, through the councils' IP&R Frameworks), those to be implemented under environmental planning instruments and development control plans under the *Environmental Planning and Assessment Act 1979* and those to be implemented by public authorities (other than the local council);
- identify the costs of those actions, proposed cost-sharing arrangements and other viable funding mechanisms for those actions to ensure the delivery of those actions is consistent with the timing for their implementation under the CMP; and
- include a coastal zone emergency action subplan if the council's LGA contains land identified within the coastal vulnerability area, and if beach erosion, coastal inundation or cliff instability is occurring on that land.

This CMP contains the above mandatory requirements and has also been prepared in accordance with the Coastal Management Manual (OEH, 2018). How this CMP meets the mandatory requirements of the CM Act and Coastal Management Manual (OEH, 2018) is detailed in Table A-2, Appendix A. Consultation with DPIE - Coasts & Estuaries has been undertaken throughout the preparation of the CMP to ensure the CMP meets the requirements of the Coastal Management Manual (OEH, 2018).

The Coastal Management Manual (OEH, 2018) specifies 5 stages of preparation of a CMP. Figure 1-5 below briefly explains these stages and highlights how the companion documents developed as part of preparing the Lake Illawarra CMP are aligned with this 5 stage process.

1.7.1 State and Regional Policies, Plans and Legislation Relevant to the CMP

Details of all plans, policies and legislation that has been considered in preparing the management actions for this CMP are outlined in Appendices A, B and C of the supporting document *Lake Illawarra Information Synthesis Report* (BMT, 2020a).

These state and regional plans and policies, as well as key legislation, were reviewed to ensure the CMP objectives and actions are consistent with the intent of these plans, policies and legislation. In addition, relevant actions and objectives of state and regional plans, including plans of management and local and regional environmental plans and strategies, were reviewed and where relevant supported through similar management actions in the CMP, or acknowledged as being implemented already.

The legislation and policies governing the management of Lake Illawarra and its catchment are complex. Legislation pertaining to the management of Lake Illawarra aims to ensure present actions, procedures, and changes to the Lake's management are in line with values that will aid its health into the future. A comprehensive overview of legislation relating to the management of Lake Illawarra was conducted as part of the *Lake Illawarra Information Synthesis Report* (BMT, 2020a).

Each piece of legislation covers a specific aspect of managing the Lake's environment. Each legislation is administered by a specific state agency. The agencies are also responsible for preparing policies, management rules and compliance action under their legislation. As an example, an object of the *Fisheries Management Act 1994* is to conserve fish stocks and key fish habitat. DPI Fisheries achieves this through establishing rules around fishing activity, policies to protect fish habitat and conducting compliance action in respect of these rules.

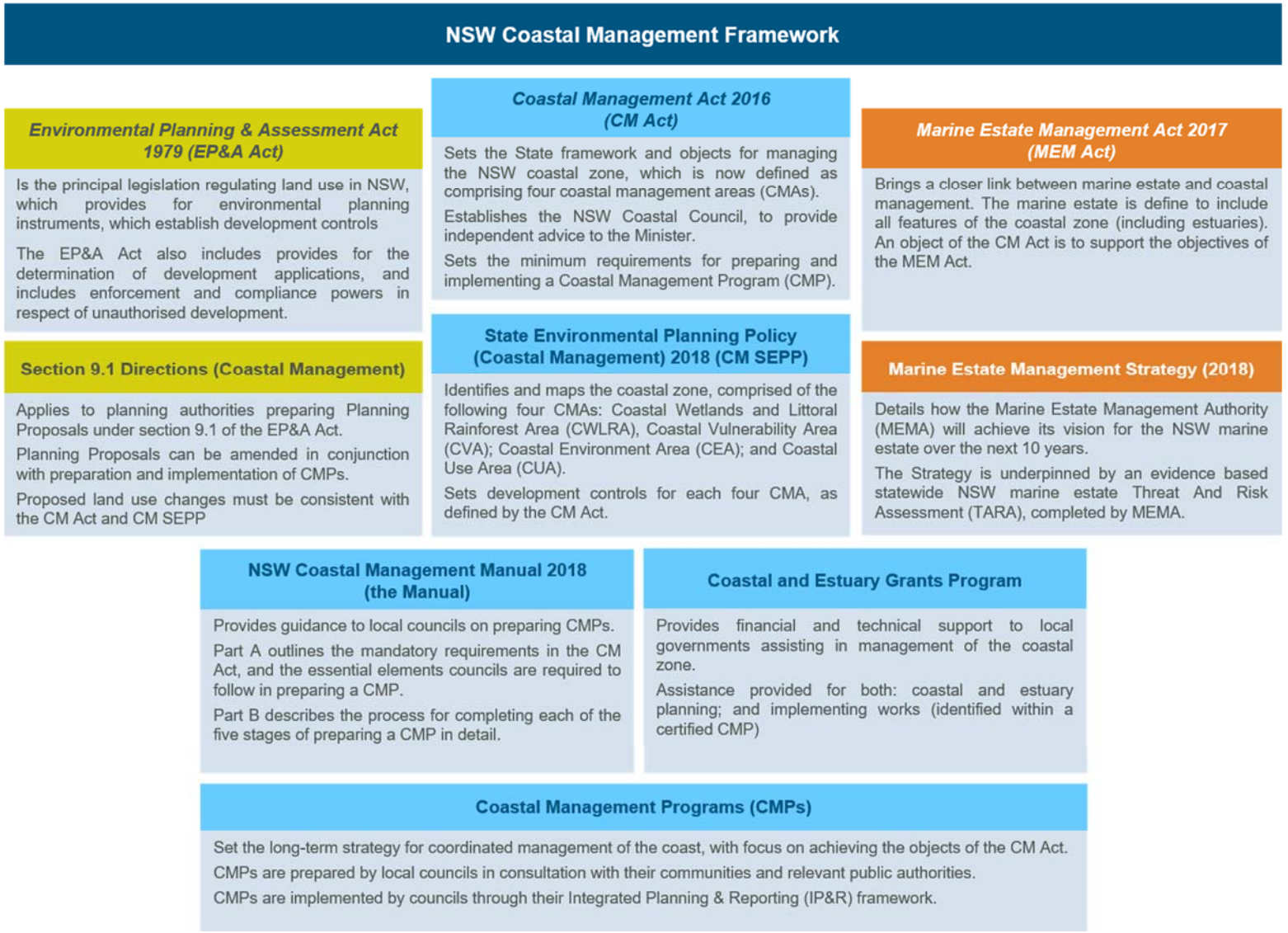
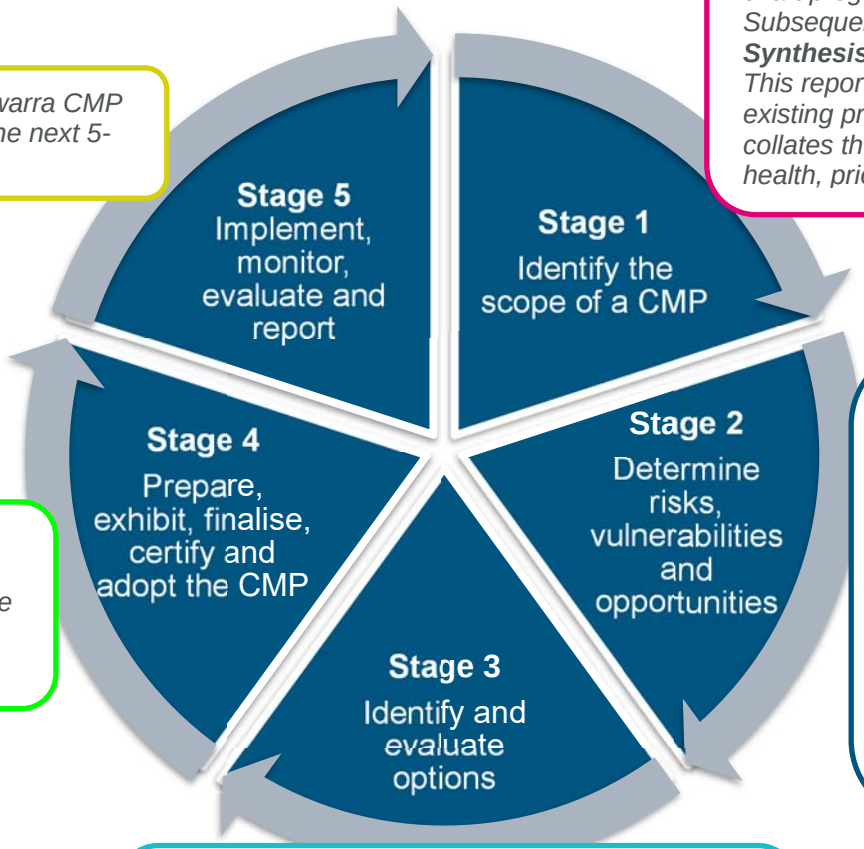


Figure 1-4 NSW Coastal Management Framework

*A standalone Scoping Study was prepared to chart progression to a Lake Illawarra CMP. Subsequently the **Lake Illawarra Information Synthesis Report** (BMT 2020a) was produced. This report provides a comprehensive review of existing process information about the Lake, and collates the understanding of threats to estuary health, prior to community input.*

Once certified, the Lake Illawarra CMP shall be implemented over the next 5-10 years.



*The **Community Uses, Values, Threats and Opportunities: Lake Illawarra** study drew from the knowledge of key stakeholders and community, to augment the knowledge contained in the Lake Illawarra Information Synthesis Report* (BMT, 2020a)*. Some 17 threats to estuary health, including coastal hazard risks, were identified and assessed, Numerous opportunities for management were identified.*

As the final step towards certification, the Lake Illawarra CMP has been placed on public exhibition, and will be further refined based upon submissions on the draft CMP.

All potential options identified through the prior reports (BMT 2019 a, b), including options listed directly from community input, and an audit of existing management regimes (Baxter et al, 2016) were collated and condensed, then subject to a detailed multi criteria cost-benefit analysis.

Figure 1-5 Alignment between the 5 Stage Process for CMPs and Lake Illawarra CMP and companion documents

1.7.2 Integration with the Marine Estate Management Strategy

To reduce social conflict and improve effective management of coastal and marine resources beyond existing marine parks, the NSW Government introduced the *Marine Estate Management Act 2014* (Beeton et. al. 2012). The Act provides for strategic and integrated management of the whole marine estate. The marine estate includes all marine waters, estuaries and coastal areas, as well as the State's six marine parks.

The NSW Government also established a new advisory Marine Estate Management Authority (MEMA). MEMA has undertaken a statewide Threat and Risk Assessment (TARA) to consider and prioritise the social, economic and environmental threats to community benefits of the marine estate. The Marine Estate Management Strategy has been prepared to allow a holistic approach to dealing with the cumulative threats to the marine estate. The nine management initiatives in this plan correspond to the cumulative threat categories identified through the statewide TARA process.

Consistency between the Marine Estate Management strategy and CMPs is an essential element listed in the Coastal Management Manual (OEH, 2018). A cross reference between the Priority Regional Threats for the Central Region and the threats identified for Lake Illawarra is included as an appendix in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b). Management measures identified within the Marine Estate Management Strategy that address key threats to Lake Illawarra have been incorporated within this CMP.

Although the statewide MEMA threat and risk assessment was undertaken at a much broader scale than Lake Illawarra, information from the MEMA background reports has been integrated into the *Lake Illawarra Information Synthesis Report* (BMT, 2020a) and the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b).

1.7.3 Coastal Zone Emergency Action Sub-Plan

In accordance with section 15(1)(e) of the CM Act, councils only need to prepare an Emergency Action Sub-Plan where there is a mapped coastal vulnerability area under the CM SEPP. Currently there is no mapping of the coastal vulnerability area in NSW under the CM SEPP.

Regardless, and as noted above, inundation relating to catchment rainfall coincident with storm event elevated ocean water levels is already managed through the NSW floodplain risk management framework. Emergency elements of the coastal inundation risk are also already managed through existing emergency action planning processes across both Councils in relation to the floodplain risk management plan, as follows:

- Lake Illawarra Floodplain Risk Management Plan (Cardno, 2012)
- Illawarra Flood Emergency Sub Plan (NSW SES, 2017)
- Illawarra South Coast Regional Emergency Management Plan (Illawarra South Coast Regional Management Committee, 2019)
- Illawarra Local Emergency Management Plan (Illawarra Local Emergency Management Committee, 2017)

In relation to other elements that comprise coastal vulnerability or hazard under the CM Act, tidal inundation risks and foreshore erosion risks (including within the entrance channel) are not considered to be of a nature requiring emergency actions, because these hazards tend to progress slowly over time rather than only in relation to storm events. Therefore, no additional actions to those already outlined for flood risk in existing processes are considered necessary to address the other elements comprising coastal vulnerability and risk in Lake Illawarra with regards to emergency response.

Rationale for not mapping a coastal vulnerability area as part of this CMP is included in Section 1.7.4 below.

1.7.4 Proposed Amendments to Coastal Management Areas

(Recommended changes to the relevant planning controls, including proposed maps)

This CMP does not propose any amendments to the existing mapping of coastal management areas currently gazetted with the CM SEPP. Suitable mapping does exist to prepare a coastal vulnerability area for the Lake, however both WCC and SCC have considered and decided not to pursue the option of a Planning Proposal to gazette a coastal vulnerability area for Lake Illawarra at this time.

No Coastal Vulnerability Area map has yet been adopted under the CM SEPP. Consequently, the relevant development controls applying specifically to development on land within the coastal vulnerability area in clause 12 of the Coastal Management SEPP are not yet active for any local government area (NSW Government, 2019).

However, despite this, clause 15 of the Coastal Management SEPP requires all consent authorities, in the context of considering proposed development in the coastal zone generally, to be satisfied that the proposed development is not likely to cause increased risk of coastal hazards on that land or other land (NSW Government, 2019). Clause 15 applies to development within the entire coastal zone and relates to any of the seven types of coastal hazard identified under the CM Act. Clause 15 states that "*development consent must not be granted to development on land within the coastal zone unless the consent authority is satisfied that the proposed development is not likely to cause increased risk of coastal hazards on that land or other land*".

When assessing proposed development on land within the coastal zone, including where there may be a risk of a current or future coastal hazard, councils and other consent authorities must consider any relevant Coastal Management Program that has been certified by the Minister (NSW Government, 2019). The NSW Government (2019) states that when assessing the risk of a current or future coastal hazard, councils and other consent authorities have discretion to consider:

- Any relevant floodplain risk management plans or estuary management plans prepared by or on behalf of a council or public authority that take into account tidal inundation in combination with catchment flooding;
- Coastal hazards identified in a relevant environmental planning instrument or development control plan;

- Relevant coastal hazard, risk and vulnerability studies prepared by an appropriately qualified expert;
- Historic data, such as past storm event data and impacts, that identify risk exposure of coastal land (such as shoreline recession, coastal inundation, or geomorphic trends);
- Relevant scientific modelling (such as relating to sea level rise and climate variability);
- Relevant advice in the NSW Coastal Management Manual and associated Toolkit; and
- Any other relevant information.

The existing coastal inundation (storm event) and tidal inundation modelling and mapping, and other relevant estuary hazard information certainly fits the above specifications. Therefore, this existing information is suitable to guide proponents in preparing development applications and to guide the councils in providing consent or conditions regarding the potential coastal risk to proposed developments.

1.8 Integrating the CMP with Each Council's IP&R Framework

A mandatory requirement for this CMP under the CM Act is to establish the links and alignment between management strategies in the CMP and objectives and strategies in the Community Strategic Plan (CSP) of both WCC and SCC.

The Integrated Planning and Reporting (IP&R) framework is a legislative requirement for Councils under the *Local Government Act 1993*. IP&R considers the longer term future of an area and is based around a CSP which reflects the community's aspirations and needs for the future. Section 8C of the *Local Government Act 1993* outlines the principles that apply to the development of the FP&R framework by councils.

The IP&R framework consists of four layers of plans:

- the Community Strategic Plan,
- the Resourcing Strategy is a 10-year plan describing the resources a council will use to achieve the objectives and strategies detailed in its CSP,
- the Delivery Program is a four-year program outlining the commitments and key partnerships required and measures to monitor success in achieving the Strategies, and
- the Operational Plan outlines in more detail the individual Actions that Council will undertake in a financial year in order to meet the commitments made in the Delivery Program.

In accordance with the CM Act, this CMP needs to align with the IP&R Framework of both WCC and SCC. This aims to mainstream coastal management into councils' overall service delivery and asset management responsibilities. It is also likely that integrating actions from the CMP into the service delivery and asset management processes of the Councils will improve implementation of CMPs.

Generally, the operational plan and delivery program will be updated on a yearly basis (as the delivery program is a rolling four-year program), and it is at this stage that actions from the CMP can and should be incorporated into these documents.

The alignment between this CMP and the strategies and objectives in the CSPs of both SCC and WCC are detailed in Table 6-1. This will assist with the process of incorporating CMP actions into the Councils' delivery programs and operational plans.

1.9 Supporting Documents for this CMP

This CMP is supported by two companion documents.

- The *Lake Illawarra Information Synthesis Report* (BMT, 2020a) which collates and reviews a wide range of data, reports, plans and policies from over the past decade or more. Topics reviewed included: physical setting, geomorphology, entrance management works, hydrodynamics, water quality, estuarine ecology, catchment influences, estuary health, community and cultural values, and climate change impacts. Existing and planned controls that apply to the Lake were also reviewed. Information gaps with respect to the estuary environment and management were identified, and a preliminary list of key values and threats was also prepared for the report.
- A *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b) compiled the community consultation activities, information and outcomes undertaken as part of the CMP process, in addition to outlining the uses, values, threats and risks associated with the Lake. A detailed risk assessment was completed as part of this report which identified the threats listed with accompanying risk rating.

The above documents do not form part of the CMP but provide supporting information to the CMP.

A number of previous studies have supported the preparation of this CMP, in addition to the above companion documents. These studies are listed below for reference.

- *Lake Illawarra Coastal Zone Management Study* (incomplete Draft, LIA 2013), from which substantial information and mapping for issues, threats and management actions has been drawn into this CMP.
- *Lake Illawarra Coastal Risk Assessment* (BMT WBM, 2013), provides details regarding actions to address of coastal inundation to Lake Illawarra within the Shellharbour LGA.
- *Wollongong Coastal Zone Management Plan: Management Study* (BMT WBM, 2017) provides details regarding actions to address of coastal inundation to Lake Illawarra within the Wollongong LGA.
- *Shellharbour Coastal Zone Management Plan Final Draft* (BMT WBM, 2016), which details coastal management actions for the open coastal zone including Warilla Beach and Windang Island.
- *Lake Illawarra Floodplain Risk Management Plan* (Cardno, 2012) and associated documents (flood study and floodplain risk management study), which provide details regarding flooding and inundation relating to catchment rainfall, with and without elevated ocean levels, and actions to manage flooding risks in Lake Illawarra, and which were used to derive flood planning levels and planning provisions in the LEPs and DCPs of WCC and SCC.

- *Lake Illawarra Estuary Management Study and Strategic Plan* (WBM Oceanics, 2006), which formed the precursor to this CMP and the 2013 draft CZMP document.

1.10 Consultation During Development of the CMP

Consultation with councils, public authorities and the community have been undertaken in accordance with a communication and engagement strategy prepared for this project. The strategy and the outcomes of the consultation undertaken to date were documented in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b). This has included consultation with the councils, state agencies and other stakeholders. A list of the identified target stakeholders for this CMP is provided in Table 1-3.

Table 1-3 Target Stakeholders

Category	Stakeholders
Key Council Staff from WCC and SCC	• Engineers • Infrastructure • Planning • Parks • Environment • Senior Management • Councillors • Asset Managers • Service Managers • Cultural Heritage Officers
State Government and other agencies and businesses	• DPIE - Coasts & Estuaries • TfNSW • DPIE Regions, Industry, Agriculture and Resources – South Coast Local Land Services (LLS) • DPIE – Crown Lands • DPI Fisheries • Sydney Water • Endeavour Energy • Energy Australia • University of Wollongong • DPIE – PA • Illawarra Local Aboriginal Lands Council • NSW Commercial Fishers • Tourism operators • Illawarra Business Chamber • Golf Club/ Yacht Club/ Bowls Club • Aishs Seafood • Futureworld Eco - Technology Centre
Community Groups	• Aboriginal Knowledge Holders and Traditional Custodians • Land care / coast care/ bushcare groups/ bush restoration teams

Category	Stakeholders
	• Rowing/ Sailing/ Yacht/ Canoe/ Dragon Boat/ Motor Boat Clubs • Recreational Fishing Clubs and Recreational Fishing Alliance of NSW • Conservation Volunteers Australia • Landcare Illawarra • Neighbourhood Forums • Scout Groups • Save the Lake • Seabird Rescue • APRA – Caravan park residents association • Shellharbour City Council Aboriginal Advisory Committee • Wollongong City Council Aboriginal Reference Group
Residents	• Foreshore landholders (1500) including caravan park residents. • Wider Catchment (90,000) • Visitors • Aboriginal Community

1.10.1 Community Support

The actions and strategies in the CMP have been developed to target the threats identified and to preserve the values of the Lake. Community consultation undertaken for this CMP, detailed in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b), indicated the following aspects to be most valued about Lake Illawarra (with over 70% of respondents valuing these aspects), shown in Figure 1-6:

- Water quality, which was the most valued aspect of the Lake:
- Views / How the Lake Looks:
- Native Wildlife:
- Access to Lake Foreshore:
- Recreational Facilities: and
- Healthy Vegetation in the Lake.

The highest threats identified during the preparation of this CMP (and described in more detail in Section 2.4, and the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b) were:

- Water pollution,
- Catchment development, and
- Entrance channel changes.

Opportunities for action identified by the community were also directly utilised in developing all actions in the CMP. The CMP will be placed on public exhibition to further demonstrate the community's acceptance for actions in the CMP.

See section 2.3 for how threats were identified.

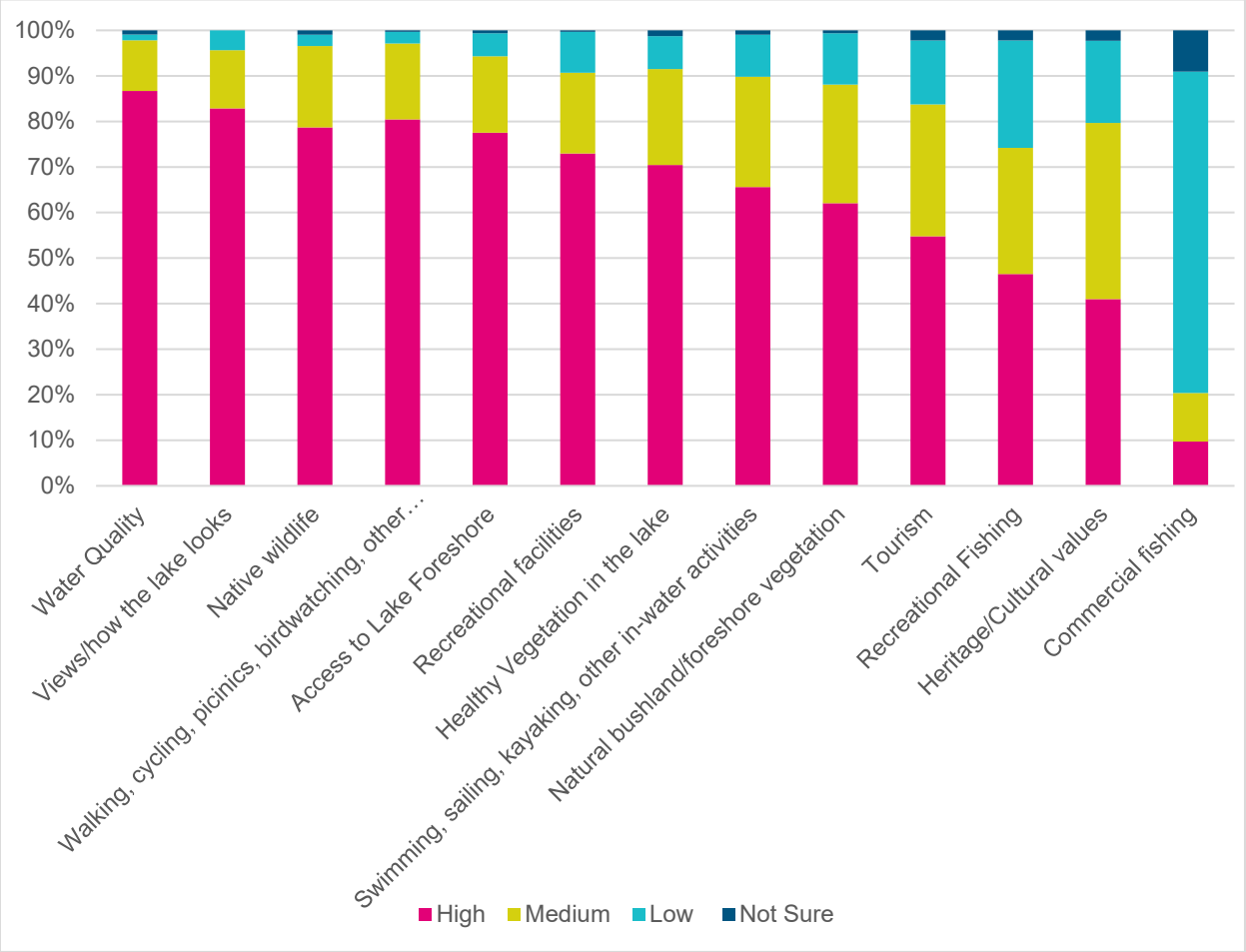


Figure 1-6 Community and Stakeholder Perception of Values Associated with the Lake

2 Lake Illawarra's Processes, Values and Threats

2.1 Chapter Overview

This chapter provides a summary of the *Lake Illawarra Information Synthesis Report* (BMT, 2020a) and the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b) that were produced as supporting documentation for this CMP. The objectives of this CMP have a strong focus on ecological health, as this underpins the social, public amenity, and economic values associated with the Lake. The summary of estuary processes below demonstrates the valuable environmental aspects of the Lake, that support its recreational, cultural and economic values.

2.2 Summary of Estuary Processes and Other Influences on Lake Illawarra

2.2.1 Physical character

Lake Illawarra is a large, shallow coastal lake, and is classified as a wave dominated barrier estuary system. From east to west, the Lake is situated between the wide, long coastal barrier system of Windang Peninsular that extends from Windang to Port Kembla (Perkins Beach) and largely impounds the estuary from the ocean; and the steep western backdrop of the Illawarra Escarpment. The Lake is fringed by low lying land, with extensive tidal flats on its eastern margin as part of Windang Peninsular and where Macquarie Rivulet and Mullet Creek flow into the estuary along its western margin.

The main waterbody of the Lake is elongated in a general southwest - northeast direction. It has a surface area of around 35 km^2 and an average and maximum water depth of 2.1 and 3.2 m respectively (LIA 2013; Sloss, 2005). The average Lake water level is around 0.2 m above sea level (OEH, 2012). The Lake Illawarra catchment covers an area of 240 km^2 (OEH, 2012). The current land uses across the catchment are illustrated in Figure 2-1. Other characteristics of the catchment are summarised in Section 2.2.6, with further details in the *Lake Illawarra Information Synthesis Report* (BMT, 2020a).

A number of major watercourses, small creeks and drainage lines drain into the Lake, with the five major tributaries being: Macquarie Rivulet; Mullet Creek; Brooks Creek; Duck Creek; and Horsley Creek.

The Lake is now permanently open to the sea via an artificially trained entrance channel between twin breakwaters, with the entrance channel positioned between Windang Island and Windang Beach. Prior to construction of the artificially trained entrance, Lake Illawarra was classified as an Intermittently Closed and Open Lake and Lagoon (ICOLL), with the entrance channel shifting from south to north around Windang Island.

2.2.1.1 Ambulatory nature of shorelines

The ambulatory and dynamic nature of the shoreline and how it may affect the study area has been considered in the CMP through using the understanding of coastal processes to inform management response. For example, the entrance channel shoreline is in a state of change as a result of the

permanent entrance opening and a consideration of this aspect has resulted in this being identified as a high risk, with management actions to reduce this risk outlined.

2.2.2 History of Management of Lake Illawarra

During the 1980s, a combination of high catchment sediment and nutrient loads, climate variations (i.e. drought periods) and natural processes resulted in poor water quality, algal blooms, seagrass dieback and significant community concern regarding the Lake's management and health. In response to the declining health and environmental condition of the Lake, the LIA was formed by the NSW Government in 1988, previously the Lake was managed by WCC, SCC and other agencies. Over the next 20+ years, the LIA managed Lake Illawarra and undertook numerous foreshore rehabilitation projects as well as algal harvesting, bank stabilisation and the construction of several gross pollutant traps and artificial wetlands around the Lake. The LIA worked collaboratively with WCC and SCC in delivering environmental and infrastructure initiatives.

Sediment and nutrient loads into the Lake continued to increase in line with ongoing development in the catchment, reducing the Lake's water quality. In an attempt to manage poor water quality by increasing tidal flushing, the Lake was substantially modified by the staged construction of a permanent trained entrance, which was completed under the LIA between 2000 and 2007. It was also intended that a permanently trained entrance would bring other social and environmental benefits, particularly building from improved water quality.

The LIA was disbanded in July 2014 and its responsibilities transferred to WCC, SCC, DPIE – Crown Lands, and Property NSW.

Foreshore land around the Lake is variously under the ownership and management of WCC, SCC, DPIE – Crown Lands, Property NSW or private landholders (including industry such as EnergyAustralia who own the foreshore land of Tallawarra Power Station).

Berkeley Nature Reserve (BNR) lies within Lake Illawarra and is actively managed by the NSW National Parks and Wildlife Service (NPWS). BNR comprises two small islands: Gooseberry Island (6.1 ha) & Hooka Island (2.0ha). The boundary of BNR extends down to the mean high water mark of each island. BNR is of international and national significance for its biological values, and regional significance for its cultural heritage and landscape values.

In 2005, a book titled "Lake Illawarra – An Ongoing History" was prepared by Joseph Davis for the LIA. This book contains a wealth of information and history regarding the Lake and should be referred to for further history of the Lake.

2.2.3 Entrance Channel Dynamics

The permanent opening of Lake Illawarra to the ocean has resulted in significant geomorphic, hydrodynamic and ecological changes. Lake water levels are permanently influenced by the diurnal cycle of ocean tides (MHL, 2013), and Lake waters are now permanently saline. The hydraulic efficiency of the entrance tidal inlet has increased significantly in association with the increased tidal prism within the Lake (MHL, 2013). Tidal range in the Lake is increasing at approximately 8mm/year, resulting in increased tidal scour (MHL, 2013).

The increased hydraulic capacity of the entrance channel has caused the migration of shoals and tidal channels, resulting in changed patterns in scour, erosion and sedimentation. The substantial impacts throughout the entrance channel are summarised below.

Significant amounts of sediment have been scoured from within the entrance channel since 2007. The marine flood tidal delta at the western end of the channel has grown significantly, extending westwards into the Lake's central mud basin (Baxter and Daly, 2010; MHL, 2013). MHL (2013) measured a net annual westward movement of marine sand into the Lake of approximately 1000 m^3/year (MHL, 2013). Bathymetry changes between 2008 and 2016 also illustrate accretion of the ebb tide delta seaward of the breakwaters (BMT, 2020a).

East of Windang Bridge, the channel has migrated northwards, with significant scouring and deepening of the channel occurring along its northern margin along the Windang foreshore, and deposition and shoaling along the southern margin of the channel. The entrance scouring and erosion has significantly undermined assets along the Windang foreshore, including the boardwalk (which has partly been removed and other sections recently closed off), boat ramp, power supply infrastructure, sections of footpath, lighting and other park infrastructure, pylons supporting the northern portion of Windang Bridge, areas of Aboriginal Cultural significance, shorebird habitat and open public space. The three groynes and a section of rock revetment have experienced significant scour at their ends and toe.

Entrance shoaling and sediment deposition along the southern margin of the channel has resulted in reduced amenity and functioning of the swimming areas near the secondary tidal channel adjacent to Reddall Reserve, with the swimming area frequently chocked with sediment. Nesting habitat for shorebirds has also been affected.

West of Windang Bridge, local erosion has also occurred within the channels and on the western side of Bevans and Cudgeree Islands (MHL, 2013). Foreshore erosion is also occurring along Picnic Islands, as well as significant movement of shoals either side of Windang bridge and along the Windang foreshore west of the bridge, due to ongoing channel adjustments. Secondary tidal channels have developed north east of Berrageree Island around Bevans Island, and along Cudgeree Bay east of Cudgeree Island. In contrast, sedimentation is occurring in the popular swimming area on the western side of Berageree Island, which has caused community concern.

Substantial losses of seagrass have been observed throughout the entrance channel due to the expansion of the flood tide delta and scouring of shoals.

Such morphological changes will continue over the next 100 years or more as the entrance channel equilibrates to the new hydraulic regime.

2.2.4 Water Quality

Different aspects of water quality are important for each of the different uses and ecosystem functions relevant to Lake Illawarra. Recreational activities (such as swimming) require water that is not contaminated by human specific bacteria, viruses and other disease or infection causing pathogens, and chemical contaminants. For ecosystem function and estuary health, water quality indicators are related to turbidity, chlorophyll *a* and nutrients, although even in a completely pristine state, these

indicators would be highly variable, fluctuating in response to natural events such as high rainfall runoff and winds. Water quality to support estuary health is directly impacted by chemical contaminants and increased sediment and nutrient loads from catchment development (in terms of both the development process and the ongoing land use that contributes to poor water quality and increased quantity), stormwater, groundwater contamination, litter and marine debris, illegal vehicle access to foreshore areas, sewage overflows, residential land uses, industrial land uses and discharges, agriculture, foreshore development, tree removal and park management practices.

In the past, the condition of the Lake was considered poor, with mass algal blooms frequently occurring (WCC, 2015). Based on monitoring since the entrance was permanently opened, WCC (2018) has found seasonal variability of water quality indicators such as chlorophyll-*a*, ortho-phosphorus and dissolved oxygen, and variability in water quality and estuary health indicators across the Lake. The data shows consistency in the water quality of the Lake across the monitoring program's duration despite seasonal extremes and anomalies (WCC, 2018a).

Prior to entrance opening, the north-eastern and south-western sections of the Lake consistently experienced significant nutrient enrichment when compared to the middle reaches, entrance, and main body of the Lake (LIA, 2006 and WCC, 2018a). Since entrance opening, this trend has continued as these regions are more enclosed and have lower rates of tidal flushing, allowing accumulated nutrients to remain, rather than be flushed out to sea with the tide, demonstrating that catchment impacts have a major influence on water quality in the Lake.

2.2.5 Ecology

The Lake contains extensive areas of protected communities such as coastal saltmarsh, swamp oak floodplain forest, littoral rainforest and extensive areas of seagrass. The three main communities of estuarine vegetation that occur in the Lake (saltmarsh, seagrass and mangroves) provide essential habitat, food supply and nutrient cycling. Valued commercial and recreational fish species (e.g. bream, flathead, blue swimmer crabs and prawns) within Lake Illawarra have been found to derive most of their nutrients from seagrass and saltmarsh habitats, the percentage contribution of each habitat type to the diet of these species varies across different locations in the lake (Gaston et al., 2019). This in turn supports fish assemblages and wildlife, contributes to good water quality and provides scenic qualities. A number of protected species rely on the Lake, such as Black Necked Storks and Pied Oystercatchers.

Estuarine vegetation is highly variable around the Lake and over time. Estuarine vegetation has been removed for land reclamation and foreshore development, with works including bridge construction, open water reclamation, shoreline hardening, and dredging undertaken in and around Lake Illawarra over the past 100 years, by both public and private land managers. Grazing animals, 4WDs and other vehicles, BMX and other bikes, informal walking tracks, and mowing and other inappropriate park management practices have and continue to impact upon fringing estuarine vegetation and riparian vegetation further upstream in the tributary creeks.

These pressures occur in addition to the permanent entrance opening and sea level rise. In response to the permanent opening of the Lake, areas of mangrove are reported to have been increasing, with signs that some of the newly established saltmarsh areas could be outcompeted by mangroves

(Baxter and Daly, 2010; Williams and Wiecek, 2017). However, the driving factor for a potential loss of saltmarsh over time is likely to be the increasing tidal range due to the permanent opening. This change in tidal range has and will be enhanced by sea level rise over time, with further impacts upon saltmarsh and mangroves to be expected.

Seagrass is particularly important for supporting fish within the Lake, as it provides a food source and shelter for different fish during different stages of their life cycles. Within the Lake, seagrass can and has been impacted by boating activities, particularly from anchors and moorings. Seagrass is protected under Part 7 Division 4 of the *Fisheries Management Act 1994* (FM Act). The FM Act sets out provisions to protect marine vegetation (mangroves, seagrass and seaweeds whether alive or dead) from 'harm'. 'Harm' under the FM Act means gather, cut, pull up, destroy, poison, dig up, remove, injure, prevent light from reaching or otherwise harm the marine vegetation.

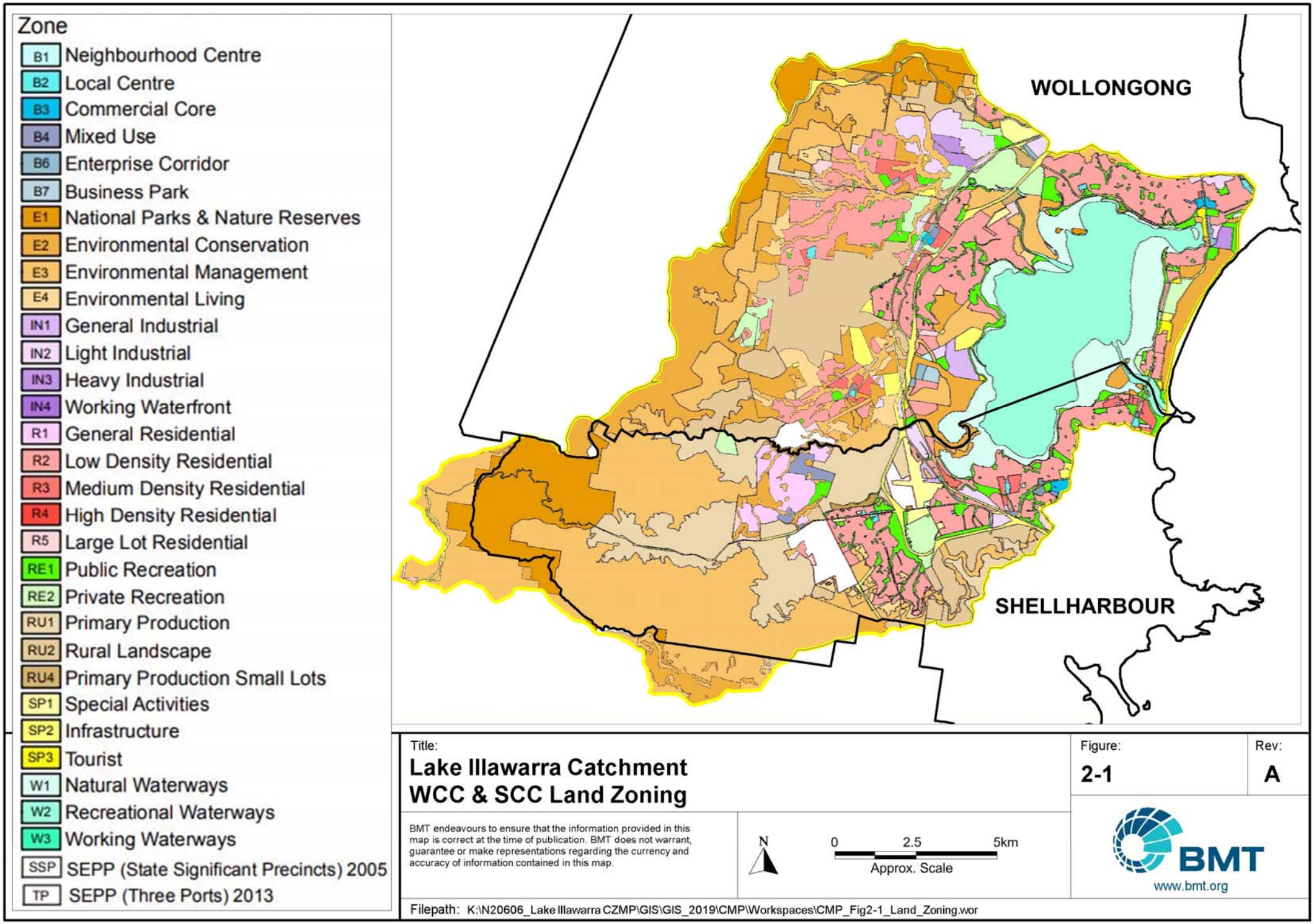
Since the permanent opening of the Lake, there is also evidence that seagrasses on the flood tide delta entering the Lake are being smothered by sand (e.g. see Wiecek et al., 2016). Seagrass is also being lost in other areas due to increased flow velocities and scour, most notably, along the channel margins that are experiencing scour. While it is understood that seagrass can naturally vary in distribution throughout the Lake, reducing human impacts will assist in nurturing seagrasses to thrive in the Lake.

Reduced estuarine vegetation combined with poor water quality will directly impact on native fauna of the Lake, including fish.

2.2.6 Influence of Population, and Growth and Changing Demographics

Today the catchment is about 60% cleared land, including urban, industrial and rural land uses, see Figure 2-1. The urban population in both Wollongong and Shellharbour has and is continuing to grow.

A large portion of the Lake's western catchment is planned to be converted to residential land. The Calderwood development in the Shellharbour LGA has already significantly advanced in the five years since October 2013. Another major development is in West Dapto, which proposes to add about 19,500 households to the catchment over the next 50 years (WCC, 2018b). The Illawarra Shoalhaven Regional Plan (DPE, 2015) states that by 2036 the population of the Illawarra-Shoalhaven region is forecast to increase by 60,400 people from 2016, taking the total population to 463,150. West Dapto has a projected population increase of almost 60,000 once fully developed. Forecast for population growth in SCC is an increase in 17,000 people between 2016 and 2036 - mainly driven by development of greenfield sites in the Lake catchment. Overall, the WCC population is forecast to increase by 43,604 people between 2016 and 2036, equivalent to approximately 20% growth across the period.


Zone
B1 Neighbourhood Centre
B2 Local Centre
B3 Commercial Core
B4 Mixed Use
B6 Enterprise Corridor
B7 Business Park
E1 National Parks & Nature Reserves
E2 Environmental Conservation
E3 Environmental Management
E4 Environmental Living
IN1 General Industrial
IN2 Light Industrial
IN3 Heavy Industrial
IN4 Working Waterfront
R1 General Residential
R2 Low Density Residential
R3 Medium Density Residential
R4 High Density Residential
R5 Large Lot Residential
RE1 Public Recreation
RE2 Private Recreation
RU1 Primary Production
RU2 Rural Landscape
RU4 Primary Production Small Lots
SP1 Special Activities
SP2 Infrastructure
SP3 Tourist
W1 Natural Waterways
W2 Recreational Waterways
W3 Working Waterways
SSP SEPP (State Significant Precincts) 2005
TP SEPP (Three Ports) 2013
WOLLONGONG
SHELLHARBOUR
Title:
Lake Illawarra Catchment
WCC & SCC Land Zoning
Figure:
2-1
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Ongoing catchment development is being felt in the Lake as poor water quality (through increased pollutant loads and water quantities both during and after development) (WCC, 2018a). The increased population in the region will also result in an increase in demands for recreational and potentially commercial usage of the Lake. This may have implications on overall estuary health and issues such as recreational opportunities, access and amenity, bank erosion, damage to ecological habitats, and private encroachments onto public land, particularly public foreshores.

Past industrial land uses have left a legacy of contamination, which through groundwater and surface water runoff can transport contaminated water and sediments into the Lake. The Lake is frequently utilised for recreational activities such as fishing, sailboarding, boating, swimming and picnics. There are some 75,000 recreational fishers in the Illawarra, many of whom utilise Lake Illawarra (West *et al.*, 2015). Boat ramps, jetties, wharves and picnic facilities support these uses in the Lake, as well as the associated commercial industries of tourism and fishing. There is a significant general commercial fishing effort in Lake Illawarra with the overall catch dominated by sea mullet, blue swimmer crab, dusky flathead and, until recently, school prawns.

The Lake contains areas of cultural significance, from both the long history of Aboriginal use of the estuary, and non-indigenous development and use of the Lake over the last 100 years.

2.2.7 Climate Change

Climate change poses a significant threat to the NSW Marine Estate, including the Lake Illawarra estuary system. As previously noted, it is recognised that Lake Illawarra is subject to coastal hazards including storm inundation and tidal inundation. Climate change, particularly sea level rise, will escalate the threat presented by inundation.

Sea level rise will result in an increase in the Lake's water level as the Lake is hydraulically connected with the ocean through the permanently open entrance. When combined with tides, this may result in the foreshores of the Lake and tributaries becoming inundated on a frequent basis with the daily tidal cycle. That is, for some areas the frequency of inundation will increase over time. For example, areas affected by a king high tide once a year at present may be affected by such water levels several times a year, perhaps even daily, in future. Hydrodynamic modelling of tidal inundation was recently completed by Kumbier et al (2019) that considered the combined impact of sea level rise and the ongoing increase in the Lake's tidal range that is occurring as a result of permanent entrance opening. The model outputs were incorporated into the risk assessment conducted in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b) for this CMP and summarised in Section 2.4.

A higher lake water level due to sea level rise also exacerbated storm event based inundation during rainfall and or ocean water level events. Coastal inundation mapping was completed on the WCC side of the Lake by Cardno (2010) using a hydrodynamic approach. For the entire Lake, Cardno (2012) completed coastal inundation mapping including current and future conditions with sea level rise using a simple water height approximation (or 'bath tub') approach. Further discussion of these hazards is provided in the *Lake Illawarra Information Synthesis Report* (BMT, 2020a).

2.3 Estuary Values of Lake Illawarra

A comprehensive account of Lake Illawarra's uses and values was developed from the combination of output of surveys and discussions with the community with the existing scientific information for the Lake (e.g. such as the values and benefits of the Lake described in BMT WBM, 2015), and which was detailed in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b). Values identified for Lake Illawarra are summarised in Table 2-1 below.

It should be noted that recreational hand gathering of cockles has been increasing in Lake Illawarra over recent years, especially over the summer of 2018 to 2019. While recreational hand gathering was not identified as a threat at the time the *Lake Illawarra Information Synthesis Report* (BMT, 2020a) and *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b) were initially prepared, given the recent exponential increase in hand gathering effort and local community concern over this activity, actions to align and assist with DPI Fisheries management of this matter have been included in this CMP.

Tourism is a key value in the Lake. Tourism values are underpinned by the environmental health and recreational opportunities offered by the Lake. The CMP is focussed on maintaining or improving environmental health and recreational amenity, and in this manner, can support a healthy tourism industry in the Lake. This CMP offers support to the other mechanisms of the Councils and State Government exist to develop and promote tourism.

Table 2-1 Community Values associated with Lake Illawarra (from the Community & Stakeholder Survey)

Value	Key points	Highly Valued*
Water quality	Good water quality is highly valued because it underpins all natural processes and human uses in the Lake.	89%
Views / How the Lake Looks	Views of the water and a natural vegetation backdrop undoubtedly contribute to the Lake's high aesthetic value, although community opinion varies as to the ratio of vegetation to waterway in views.	81%
Native wildlife	Native wildlife is supported by a healthy lake ecosystem and catchment habitats and supports the biodiversity and productivity of the Lake. The community values native wildlife for birdwatching, nature conservation and its aesthetic value.	80%
Access to Lake Foreshore	8 boat ramps, 13+ jetties/wharves, and foreshore access supports in-water activities (see below). Foreshore parks/reserves support foreshore activities (see below).	78%
Recreational Facilities	As above, plus picnic, shelter and playground facilities, the bicycle shared pathway, and walking tracks. Some infrastructure is aging and doesn't meet peak demand.	73%
Healthy Vegetation in the Lake	Saltmarsh, seagrass and more recently mangroves provide essential habitat, food supply and nutrient cycling. This in turn supports fish abundance, wildlife and good water quality, which also supports scenic and recreational values.	71%
Foreshore Activities	Popular activities include walking, bike riding, picnics, barbeques, bird watching, bushwalking, bush regeneration, and are supported by Access to the Lake Foreshore and Recreational Facilities (see above).	69%
In-water Activities	Popular activities include swimming, kayaking, sailing, boating, as supported by Access to the Lake Foreshore and Recreational Facilities (see above).	65%
Natural bushland / Foreshore vegetation	Riparian vegetation and catchment bushland support wildlife, as well as filtering water of nutrients and pollutants before it enters the creeks and Lake. The community appreciates the natural beauty provided by riparian vegetation, with a small segment noting foreshore trees impede their views.	64%

Value	Key points	Highly Valued*
Tourism	An exact dollar value on the contribution of Lake Illawarra to the tourism economy is not possible, however, the natural and recreational values noted above for the Lake contribute directly to attracting visitors to the local area.	51%
Recreational Fishing	This popular activity includes boat based and shore based line and trap fishing, and hand gathering.	45%
Heritage / Cultural Values	Lake Illawarra remains strongly significant in Aboriginal culture. It supported established campsites of the Yuin people and a diverse and sustainable source of food and fresh water for some 20,000 years prior to European settlement. 'Official' European settlement of the Illawarra region commenced in 1816. It has profoundly impacted the Lake: positively toward the way we value the Lake today; and negatively due to the displacement of the Aboriginal people from their land and waterways, introduction of foreign plants and animals, land clearing for dairy and cattle farming, cedar cutting, and landscape changes from coal mining.	40%
Commercial Fishing	Commercial fishing contributes ~ $1M annually at first point of sale, plus further lifecycle economic value. It is permitted under an "Estuary General" licence covering Wollongong to Ulladulla. Commercial fishers primarily use mesh and haul netting and crab traps, and dominantly catch sea mullet, blue swimmer crab and dusky flathead.	8%

** Refers to the percentage of respondents who classified the value as "high" in surveys conducted for this project and documented in Appendix C of the Community Uses, Values, Threats and Opportunities: Lake Illawarra Report (BMT, 2020b).*

2.4 Threats Identified for Lake Illawarra

(A snapshot of issues affecting the areas to which the CMP applies)

Threats relate to activities that directly or indirectly impact upon the values and benefits associated with the Lake Illawarra estuary. Threat is often characterised by a reference to potential events and consequences, or a combination of these (ISO 31000:2009). In the context of this study, a threat may include a driver (issue, activity or process) that results in a detrimental impact(s) or consequences(s) to the values or benefits of the study area. For example, stormwater runoff (driver) may result in a detrimental impact to water quality (value). In the context of this CMP, the threats directly relate to the issues as per the terminology of the CM Act and the Coastal Management Manual (OEH, 2018).

The Lake Illawarra catchment is in a period of significant land use change, with new residential developments underway. This is in parallel to the ecosystem response to permanent changes to the entrance condition and tidal hydraulics of this already highly dynamic lake system. It is also a period of transition in governance in response to the disbanding of the LIA and transition to management by SCC, WCC, and the state government (DPIE – Crown Lands, Property NSW) with respect to the entrance management works and foreshore lands. Considerable effort has been expended by the former LIA, SCC, WCC and DPIE and other researchers to identify, document and manage the environmental, social and economic values and issues associated with Lake Illawarra.

Through the course of preparing the *Lake Illawarra Information Synthesis Report* (BMT, 2020a) and *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b), a list of threats to the condition and values of Lake Illawarra were identified. Refer to Section 5 of BMT (2020a) for further details on threats. The threats were then assessed through a threat rating process that considered the frequency of the threats, and the environmental, social and/or economic

consequences of the threats across both present day and future timeframes (refer BMT (2020b) for further details on the threat rating process).

How the level of threat may change over time due to such influences as population growth, urban development and climate change has also been assessed for the medium term (2040-2050, or 20-30 years from present) and long term (2070-2100+, or 50-100 years from present), as explained in Table 2-2. Furthermore, coastal vulnerability assessments such as storm event coastal inundation and tidal inundation were based on deterministic models with set timeframes. Specifically, present, 2050 and 2100 timeframes were investigated for coastal inundation modelling for storm events (ocean water levels) by Cardno (2010, 2012); and present (2016), 2040, 2070 and 2100 timeframes were investigated for tidal inundation modelling by University of Wollongong (Kumbier et al, 2019).

Some threats can be expected to escalate over time, particularly where the threat is affected by urban development, geomorphic changes and climate change. Other threats may remain similar over time. Understanding how the threats will change over time is important in designing management actions for the next 10 years of the CMP and determining and then managing the long term intent for the Lake.

For the purposes of this CMP, current and future threats with potentially high consequence but with a very low probability of occurring within the study region were not included for assessment (e.g. tsunami). For this CMP threat assessment events with a probability of out to 1% AEP (1 in 100 years) were determined to be a sufficient extent for consideration.

It is also recognised that a disengaged community can threaten the success of implementing the CMP and managing the Lake. Many actions in the CMP to treat the direct threats involve education and involvement of the local community, and this is in recognition of the importance of the community to the success of implementing the CMP and managing the Lake.

The final prioritised list of threats and their level of present and future threat is provided in Table 2-2. The development of objectives and management actions for this CMP has focused on the treatment (reduction, elimination, mitigation) of these priority threats. Furthermore, Section 4 outlines the actions to address the issues (termed "threats" for the purpose of this CMP) in accordance with Section 15 (1) (b) of the CM Act and associated wording of the Coastal Management Manual (OEH, 2018).

Table 2-2 Identified Threats Impacting Lake Illawarra

Threat	Threat Rating			Brief Description
	Present Day	Future: 2040-2050	Future: 2070-2100+	
Water pollution	Very High	Very High	Very High	Water quality conditions in estuaries fluctuate as a function of natural processes and human pressures. Water quality in Lake Illawarra is influenced by: urban runoff that discharges into creeks and stormwater outlets connected to the Lake; groundwater flow (in some cases contaminated); tidal exchange with the ocean; mixing of salt, fresh and brackish water; and contamination from sediments. Considering the current rate of urban development, future population growth plans and the increase in tourist visitation forecast for the Lake Illawarra region, it is anticipated that water pollution will continue to be a high threat into the future. Key drivers such as catchment pollution, stormwater runoff and sewage overflows will persist and increase in severity with regional growth if not adequately managed.
Catchment development	Very High	Very High	Very High	Catchment development results in the mechanical disturbance of undeveloped land in addition to an increase in impervious surfaces. This in turn may reduce water quality, increase water quantity, disturb and fragment habitats and increase the demands on community spaces and facilities. Further substantial development is planned for the Lake Illawarra catchment. When forecast population growth and urban development plans for the region are considered, and then combined with climate change, catchment development is likely to remain a very high threat over the medium to long term if adequate management action is not taken.

Threat	Threat Rating			Brief Description
	Present Day	Future: 2040-2050	Future: 2070-2100+	
Changes due to Entrance Channel opening	Very High	Very High	Very High	Entrance training works to keep the Lake permanently open to the ocean has caused significant geomorphic, hydrodynamic and ecological changes to the Lake. The water level of the Lake has dropped but the tidal range has been increasing, and this is expected to continue as the entrance channel continues to evolve (scour and migrate) in response to the increasing tidal velocities in the channel from a permanently open entrance. The East Coast Low event in June 2016 caused erosion to occur from floodwaters, locally generated wind waves, tidal current and swell wave action within the entrance. In addition to the 2016 storm, the Lake margins in and around the entrance channel continue to respond to the changing tidal regime (increased tidal prism and velocities) introduced through the entrance training works. Areas within the entrance channel continue to erode and at an increasing rate. This has already impacted the boardwalk, Windang Bridge, areas of Aboriginal Cultural significance, shorebird habitat, open public space and other assets within the entrance channel. Other areas within the entrance channel have experienced accretion (e.g. flood tide delta, swimming areas) and have required dredging in the past to maintain both navigation and recreational amenity. Channel migration causing erosion and accretion may impact upon navigation and will require monitoring and management. Sea level rise will exacerbate the threats associated with entrance channel opening. As the Lake is hydraulically connected with the ocean, sea level rise will directly increase the mean lake water level. The combination of sea level rise and ongoing increase in the tidal range of the Lake will result in low lying foreshores becoming permanently inundated by the end of the century and beyond.
Loss of estuarine vegetation	High	High	High	Estuarine vegetation such as saltmarsh, mangroves and seagrass communities provide habitat and food for a range of fish species, birds, mammals, insects and invertebrates. Lake Illawarra has extensive areas of vegetation considered to be of significant natural value that in turn support the biodiversity and productivity of the Lake. If not managed, increased catchment development and population will continue to place pressure on estuarine vegetation through clearing for development and recreation. The increasing tidal range within the Lake as a result of the permanent opening will place additional stress on estuarine vegetation over time. Increased water temperatures due to climate change could exacerbate this threat by enhancing conditions for weed infestation.
Wetland degradation	High	High	High	Coastal wetlands occur in specific environmental niches and are sensitive to water quality change and mechanical disturbance. At Lake Illawarra, some areas of wetland that have high ecological potential are being degraded by human activities. If not adequately managed, this threat is likely to increase in the future due to the increased population forecasts and urban development for the region.

Threat	Threat Rating			Brief Description
	Present Day	Future: 2040-2050	Future: 2070-2100+	
Litter, plastics and marine debris	High	High	High	This includes rubbish and litter reaching the Lake through stormwater, direct dumping and fishing waste. Long term pollution from degraded plastic results in possible toxic chemical pollution, and the increasing presence of plastic micro beads and disintegrating synthetic fibres compounds this threat. Plastics in these forms can significantly negatively impact on fish and other marine animals. It is anticipated that the threat of litter, plastics and marine debris will present the same level of threat across the short, medium and long term future timeframes. Management actions and education will improve some of the general population's behaviours regarding littering however this improvement is likely to be offset by the notable population increase expected in the Illawarra region.
Contaminated sediments	High	High	High	Contaminated sediments are known to occur within Lake Illawarra, with particularly high concentrations being measured in sediments amongst some saltmarsh areas due to adjacent historical land uses, and generally within the tributaries as a result of urban developments. Contaminated sediments can release pollutants into the water column and degrade water quality. Generally, the contaminants are a threat to lake ecology through bioaccumulation in fish and other species, which in turn poses a threat to human health. Where sediments remain undisturbed and continue to be overlain by new, clean sediments, the threats from the contamination would progressively reduce. Conversely, if sediments are scoured during flood events or through dredging, contaminants could be released. Until an appropriate method to rehabilitate contaminants from sediments is implemented, they will continue to present the threat of releasing pollutants into the Lake into the future. Therefore, the threat from contaminated sediments has been assumed to remain high into the future.
Inappropriate / degraded / insufficient infrastructure	High	High	High	There is a range of coastal infrastructure within and around the Lake that have been constructed both historically and recently to improve amenity, access and other human use aspects of the Lake. There remains uncertainty about who owns and is responsible for the management and upkeep of infrastructure and this exacerbates this threat. In addition, inappropriate infrastructure occurs and is most prevalent within the entrance channel. As sea level rise and climate change impacts are observed, changes in estuary water levels and associated tidal regimes will continue to put existing infrastructure at threat. Ongoing urban development and population growth will increase usage and demands for infrastructure into the future. Therefore, the threat of inappropriate, degraded and insufficient infrastructure will continue to be high.

Threat	Threat Rating			Brief Description
	Present Day	Future: 2040-2050	Future: 2070-2100+	
Loss of tangible and intangible cultural heritage	High	High	High	This threat relates to known and unknown sites and places as well as less tangible aspects such as cultural fishing, cultural resource use, places, stories and traditions. Concerns have been raised around the costs of licences and regulations associated with access and restrictive catch, a lack of open space adjacent to the Lake available for cultural activities and loss of tangible cultural heritage due to factors such as coastal development and rising sea levels. Aboriginal cultural heritage sites and places will continue to be impacted into the future due to permanent entrance opening and sea level rise that will endanger sites in low lying areas. For this reason, this threat has been assumed to remain high into the future. Ongoing urban development will also place pressure on these sites, although existing regulatory requirements are intended to prevent or mitigate impacts from development on Aboriginal cultural heritage.
Foreshore development encroaching public land	Medium	High	Very High	Residential areas fringe a large proportion of the Lake's boundary, however areas of public land (Crown land or Council land) usually separate private land from the Lake's foreshore. In some places, private landholders seek to extend their land holdings across the foreshore with action such as mowing, signs and small scale illegal foreshore development (e.g. BBQ areas) on public land. Tidal inundation will continue to squeeze private and public foreshores, and in some areas public foreshore may be lost. This is expected to increase the threats of foreshore development encroaching on public lands, as foreshore lands are reduced and as residents attempt to mitigate unstoppable inundation impacts. Therefore, the threat is expected to increase over time.
Loss of riparian habitat	Medium	High	Very High	Riparian vegetation around the Lake has a range of aesthetic and ecological values. Changes to the extent and condition of various estuarine vegetation communities can occur in response to the health and physical condition of the Lake. Sea level rise and tidal inundation will exacerbate pressures on riparian habitats in locations where they cannot migrate in response to inundation, and this may result in a loss of habitat over time. Therefore, the threat of loss of riparian habitats is expected to increase into the future.
Foreshore and bank erosion	Medium	High	High	Erosion threatens a number of foreshore areas across the Lake and embankment areas of inflowing waterways. There are several processes that drive erosion around the Lake margin, including loss of riparian vegetation, mechanical disturbance, stormwater discharge, floodwaters, local wind wave action, tidal currents and ocean swell wave penetrating the entrance channel. Sea level rise, increasing stormwater discharge and changes to the tides and storm swells are likely to escalate the frequency of bank and foreshore erosion. The threat rating for this threat is expected to increase to High across the next 20, 50 and 100 years.

Threat	Threat Rating			Brief Description
	Present Day	Future: 2040-2050	Future: 2070-2100+	
Climate change	Medium	High	High	Climate change and rising sea level will impact the water level within the Lake. This threatening process will potentially increase the loss of saltmarsh areas, the occurrence and levels of inundation of public and built assets and cultural heritage items/places. The threat of climate change will progressively increase in threat rating and severity across the next century. Climate change impacts particularly sea level rise will be linked with several other threats over the 20, 50 and 100 year timeframes including coastal and tidal inundation, foreshore erosion and loss of riparian vegetation.
Park management practices impacting adjacent natural areas	Medium	Medium	Medium	Council Park managers responsible for maintaining the foreshore areas can sometimes have impacts on sensitive areas such as saltmarsh through mowing practices. Increased tourism and population growth in the region will result in added pressure to maintain foreshore areas to a high standard. However, the threat rating for this threat is expected to remain the same (or potentially decrease if adequate management actions and staff training is implemented).
Commercial fishing	Medium	Medium	Medium	Commercial fishing is managed by DPI, and changes to local fishing regulations are beyond the scope of the CMP. There are community concerns regarding the perceived impact on the Lake from commercial fishing, which is in contrast to the known community benefits to the local region from commercial fishing, such as the supply of locally sourced seafood and bait and provision and upkeep of infrastructure (e.g. jetties) by the fishing industry. Regional population growth and increased tourist visitation to the Illawarra region will continue to increase the demands on local commercial fishing, although suitable management measures such as the Fishery Management Strategy are in place to manage this and maintain suitable productivity and protection levels. Therefore, the threat level is expected to remain at medium over time.
Inefficient/ Incorrect Lake management	Medium	Medium	Medium	In July 2014, the Lake Illawarra Authority (whom previously managed the Lake) was disbanded and responsibilities transferred to various state agencies as well as WCC\SCC. Recently the LIEMC was established as a collaborative effort between councils. This ongoing transition of responsibilities poses a threat to longer term Lake management. This threat will continue at the same level of threat (Medium) until the transition of Lake management is finalised. The CMP is an important tool for providing integrated management of the estuary in line with current and future values and needs and will assist with consistent Lake management.
Introduced species	Low	Medium	Medium	Plant and animal (plus fungi) species that are not native to Australia are referred to as introduced species. Since European settlement the Lake Illawarra ecosystem has had to compete with a range of introduced animals and plants. The threat of invasive species is likely to increase to a threat rating of Medium over the medium to long term. As climate change impacts put added pressure on ecological communities and native species, the prevalence of introduced species in the Lake and catchment could increase. This is because native species may be weakened by climate change, allowing for better adapted invasive species to dominate.

3 Selecting Management Actions

3.1 Management Strategies

To better direct management attention towards addressing the identified threats to Lake Illawarra, a set of management strategies were compiled. A total of nine management strategies were identified, and prioritised based upon the threat rating for the threats directly addressed by each strategy, as in Table 3-1 (although it is noted that many of the strategies indirectly address many of the threats). That is, Table 3-1 only illustrates where a management strategy most directly addresses a threat. The aim of this approach to developing the strategies was to identify one management strategy for each threat, or group of threats where the management approach would be similar.

A full analysis of how individual actions beneath each strategy directly and indirectly address the threats is provided in the *Lake Illawarra CMP Management Actions Assessment* (BMT, 2020c).

3.2 Developing Management Actions

A total of 212 potential actions were compiled directly from the audit of the previous management plans for the Lake by Baxter et al (2016), recommendations developed during the *Lake Illawarra Information Synthesis Report* (BMT, 2020a), and from community and agency input listed in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b).

To implement each broad management strategy, a subset of specific management actions was developed using the pool of potential actions identified as outlined above. Management actions may be designed to reduce the likely occurrence or frequency of a threat, the consequence of a threat or both. The actions may also treat more than one threat, directly or indirectly. The management actions also include monitoring and other data collection actions, which may substantially improve approaches to management in the future by providing better information about the occurrence/frequency and / or consequence of key threats.

There are many aspects of the management of Lake Illawarra that can be targeted through the coastal management framework and there are some aspects that are beyond the reach of this process. Development of management actions was focused on those mechanisms that are available through the CMP process.

In general, management actions may utilise a variety of implementation mechanisms that can act at different levels or on different aspects of the problem. The different types of management actions include:

- Planning and development controls;
- Physical works, such as foreshore protection structures, amenity facilities etc;
- Rehabilitation works;
- Education and awareness programs, and;
- Monitoring programs, data collection and assessments.

The list of potential actions was initially assessed by determining which of the nine management strategies each action fell within. The actions within each strategy were then distilled by grouping the same or similar actions or compiling actions with the same or similar intent. Those actions that could not be grouped were either retained as stand-alone actions or were directly culled through a coarse cost benefit assessment.

This process left a total of 41 management actions for detailed multi-criteria analysis to further refine the actions, as explained in Section 3.3. The *Lake Illawarra CMP Management Actions Assessment* (BMT, 2020c) contains the full list of 212 potential actions, the strategy categorisation, and the action each has been rolled up in to, or otherwise, the outcome of the coarse cost benefit filter.

Table 3-1 Management Strategies and Threats Addressed in Prioritised Order

Threats / **Management Strategies**	Water pollution	Catchment development	Changes due to Entrance Channel Opening	Loss of estuarine vegetation	Wetland degradation	Litter, plastics and marine debris	Contaminated sediments	Inappropriate / degraded / insufficient infrastructure	Loss of tangible and intangible cultural heritage	Foreshore development encroaching public land	Loss of riparian habitat	Foreshore and bank erosion	Climate change	Park management practices impacting adjacent natural areas	Commercial fishing	Inefficient Lake Management	Introduced species
	Very High	Very High	Very High	High	High	High	High	High	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Low
Improve Water Quality																	
Improve Planning & Management Arrangements for the Lake																	
Manage Changes to the Entrance Channel																	
Protect and Rehabilitate Estuarine and Riparian Vegetation																	
Maintain and Improve Recreation and Amenity																	
Protect and Promote Cultural Heritage																	
Manage Foreshore and Bank Erosion																	
Prepare for Inundation Risks																	
Protect and Manage Key Fauna																	

3.3 Multi-Criteria Cost Benefit Analysis

A total of 41 actions were subject to a multi-criteria cost benefit analysis, after which, 36 actions were initially selected for implementation.

The multi-criteria cost benefit analysis involved two components, the outputs from which were combined to determine if the action should be implemented in the CMP. The components were:

- Assessment of the ability of the action to mitigate the threats to the estuary, producing a threat mitigation score (see Section 3.3.1), and
- A cost benefit analysis considering seven criteria (see Section 3.3.2), then
- Scores from the above two components were combined to take advantage of actions with high threat mitigation scores and / or high cost benefit analysis scores within the practical financial capabilities of the councils (see Section 3.3.3).

Each step of the multi-criteria assessment is explained in the following sections.

3.3.1 Threat Mitigation Assessment

The potential merit of each action was assessed by determining the influence of the action in mitigating the identified threats to Lake Illawarra. This involved considering the direct or indirect impact of the action on each threat identified for the Lake. The direct or indirect influence could be positive or negative and was scored as according to Table 3-2.

The influence of each of the 41 actions on mitigating all 17 threats was scored. The scores were then weighted according to the threat level of each threat, as follows:

- Very high threats were given a weighting of 4,
- High a weighting of 3,
- Medium a weighting of 2, and
- Low a weighting of 1.

Each influence score was multiplied by the weighting for that threat, then added to give a cumulative Threat Mitigation Score.

To explain the threat mitigation scoring process, the scoring for Action EV1 “Rehabilitate vegetation along lake foreshores and creek banks” is provided as an example in Table 3-3.

Threat mitigation scores (TMS) for the 41 actions ranged from 59 (Action PM2 “Provide ongoing coordinated management of the Lake”) to -12 (Action RA5 “Undertake dredging of bays within the Lake”). The threat mitigation score provided a clear picture of the likely influence of the various actions on the priority threats, prior to further cost benefit analysis. The influence scores and cumulative threat mitigation score given to each action is provided in *Lake Illawarra CMP Management Actions Assessment* (BMT, 2020c), noting that because this analysis was undertaken prior to Public Exhibition, the action numbers may not align with those in this CMP document.

Table 3-2 Threat Mitigation Potential

Influence	Score
Direct positive	2
Indirect positive	1
No influence	0
Indirect negative	-1
Direct negative	-2

Table 3-3 Example Threat Mitigation Score Process

Action ID	Action Descriptor	Entrance channel changes	Water pollution	Catchment development	Loss of estuarine vegetation	Wetland degradation	Litter, plastics and marine debris	Contaminated sediments	Inappropriate / degraded / insufficient infrastructure	Loss of tangible and intangible cultural heritage	Foreshore development encroaching public land	Loss of riparian habitat	Foreshore and bank erosion	Future climate change	Park management practices impacting adjacent natural areas	Commercial fishing	Introduced species	Cumulative Threat Mitigation Score (TMS) Weighted according to risk rating of threat
	Risk Rating	Very High	Very High	Very High	High	High	High	High	High	High	Medium	Medium	Medium	Medium	Medium	Medium	Low	Very high (x4) High (x3) Medium (x2) Low (x1)
		2=direct positive influence, 1= indirect positive influence, 0 = no influence, -1 = indirect negative influence, -2 indirect negative influence																
Strategy 4: Protect and Rehabilitate Estuarine and Riparian Vegetation (EV)																		
EV1	Rehabilitate vegetation along lake foreshores and creek banks.	1	1	0	2	2	1	1	0	1	1	2	2	1	1	0	1	44

3.3.2 Cost Benefit Analysis

Each of the 41 actions were then assessed for costs and benefits against seven different criteria, namely:

- **Capital Cost** to implement the action initially, with values generally set around the levels at which Councils would need different tendering procedures and approvals before proceeding;
- **Ongoing Costs per annum**, with cut off values generally a quarter to a half of that of the capital cost to implement;
- **Effectiveness**, being the ability of the action to reduce the threat for which the action has been designed or targeted, or otherwise, the provision of important data or knowledge about the target threat by the action;
- **Community Acceptability**, which is based upon general feedback from this locality and other coastal areas regarding the action or type of action;
- **Reversible / Adaptable in the Future**, being the ability for the action to be modified or removed in future, should the situation change, and an alternative approach be required. This is particularly

important where influences such as ongoing channel dynamics and climate change may modify the issues or threats and how they can be managed in future.

- **Legal / Approval Risk**, to highlight the legislative and approval requirements (or impediments) to implementing an action within the current legal framework; and
- **Technical Viability**, to highlight where certain actions may or may not be technically feasible or would require significant engineering (or other) investigations and construction / implementation capabilities.

Scoring for the cost benefit analysis followed a "traffic light" colour system, whereby for each action, the criterion was assessed as either:

- **GO**, with a score of 1
- **SLOW**, and proceed with caution, with a score of 0; or
- **STOP**, with a score of -1.

The "traffic light" rating system for the criteria in the cost-benefit analysis is outlined in Table 3-4. Each of the criterion were given equal weighting. The total score for each action was therefore based on a direct addition of scores against each criterion. Scores for the actions ranged from:

- 7 (WQ1, WQ6, PM4, CH1, FB3, IR1, IR2, IR4, IR5, MF1, see full descriptions in Chapter 4), to
- 1 (EV6, RA5, both of which did not pass the selection process, see the *Lake Illawarra CMP Management Actions Assessment* (BMT, 2020c)).

The outcomes of the cost benefit analysis for each action against each criterion is provided in the *Lake Illawarra CMP Management Actions Assessment* (BMT, 2020c).

Table 3-4 Cost Benefit Analysis Criteria and Scoring System

Outcome	Capital Costs	Ongoing Costs per	Effectiveness	Community Acceptability	Reversible / Adaptable Future	Legal / Approval Risk	Technical Viability
STOP	Very expensive (>$300,000)	Very expensive (>$150,000 p.a.)	Option is unlikely to be effective / substantially reduce targeted threats	Unlikely to be acceptable to community and politically unpalatable; Extensive community education, endorsement by Minister(s) and Council required	Option is irreversible once implemented; Option limits alternatives options in the future	Will require an EIS and/or Govt program to implement; There is a residual risk that approval will not be obtainable for the proposed works / strategy	Is unlikely to be technically viable without substantial engineering (or other) design investigation and capabilities for implementation
SLOW	Moderately expensive ($100,000 - $300,000)	Moderately expensive ($25,000 - $150,000 p.a.)	Option will not necessarily reduce targeted threat(s) but will provide important knowledge / data about the threat OR Option will bring a minor reduction in the targeted threat(s)	Would be palatable to some, not others (~50/50 response); Briefing to Councillors, GM and community education required	Option is reversible or adaptable, but at considerable cost / effort	Will require Govt approvals to be implemented, or assistance through existing Govt program;	Is likely to be technically viable at the site, but would require further investigations to clarify
GO	Limited cost (<$100,000)	Limited cost (<$25,000 p.a.)	Option will be very effective in eliminating / reducing / remediating its target threat(s)	Is very politically palatable, acceptable to community; Minimal education required	Option can be easily adapted for future circumstances or should impacts not occur, option would not negatively impact future generations	No or minimal government approvals required to implement	Is technically viable at the site / location

3.3.3 Overall outcome

The threat mitigation score provided an indication of an action's ability to mitigate more than one threat, directly or indirectly. However, this score does not indicate how costly or viable it is to implement such an action.

The cost-benefit analysis provided an indication of the financial, technical or other constraints or opportunities associated with each action, including the effectiveness of the action in meeting its aims. However, this score does not explain the ability of the action to mitigate the priority threats.

The thresholds described in Table 3-5 were therefore established to enable selection of actions to implement through this CMP. The aim of the thresholds was to sensibly combine the threat mitigation and cost benefit analysis scores, but still capture actions that are a very good idea from either a threat mitigation perspective or from a cost-benefit perspective. That is, some actions have a very high threat mitigation score, but may be a little more costly or resource intensive to implement. These actions should still be pursued because of their overall environmental and social benefit. Conversely, there are actions with a lower threat mitigation score, but that are highly efficient and low cost to implement. Indeed, for some such actions, their lower threat mitigation score reflects the fact that the action is specifically targeted to one threat (e.g. MF1 "Monitor and protect shorebird nesting sites on a yearly basis" had a TMS = 17 and CBA = 7). Such actions should certainly be pursued because of how well they are likely to treat the target threat, and at a high benefit to cost ratio.

The thresholds were also set to exclude actions that may have a high threat mitigation score but are simply too costly and difficult to implement; or likewise, that may be simple and inexpensive to implement, but are unlikely to bring any real benefit to the Lake.

The overall outcome for each action against these thresholds is provided in the *Lake Illawarra CMP Management Actions Assessment* (BMT, 2020c). Based upon the total multi criteria (threat mitigation and cost benefit) assessment, 36 actions resulted. Implementation details for the selected strategies and actions are provided in Chapter 4.

3.4 Changes to Actions After Public Exhibition

Following the public exhibition of the draft CMP document, substantial community concern was raised for a few specific lake management issues (e.g. the ability to undertake dredging, should this be needed in future). The high level of community concern prompted a further 4 actions to be added to the CMP, namely WQ8, RA4, RA5 and RA6. These new actions were then vetted through LIEMC, WCC, SCC, relevant state agencies and stakeholders and the community, prior to their inclusion in this CMP. While these four new actions were not assessed through the multi-criteria matrix, they were like other actions that had been analysed and phrased to ensure consistency with the 'slow' or 'go' categories used for the cost benefit analysis. For example, large scale dredging was previously considered in the multi-criteria assessment and resulted in a 'stop' due to the high costs associated with the action. This action was replaced with RA6, which is to do an investigation into the viability of dredging, rather than actual broadscale dredging. This action and RA5, small scale dredging, have costs of up to $300,000, which falls into the 'slow' category. Small scale dredging as proposed in RA5 would also have much less environmental impacts than broad scale whole of bay dredging.

Likewise, some of the actions from the public exhibition draft CMP were rationalised or expanded. For example, the water quality monitoring actions WQ7, WQ8 and WQ10 from draft CMP are now action WQ7 only, and the entrance channel action EC3 now expanded to cover emergency works.

For ease of reference for reviewers, public exhibition draft CMP Action numbers and current CMP action numbers are outlined in the *Lake Illawarra CMP Management Actions Assessment* (BMT, 2020c).

This CMP provides the approved actions to be taken forward for implementation. The final number of actions in the CMP is 39. Implementation details for all actions are provided in Chapter 4.

Table 3-5 Threat Mitigation and Cost Benefit Analysis Thresholds for Selecting Actions for Implementation

Threat Mitigation Score (TMS) + Cost Benefit Analysis (CBA) combination	Implementation Outcome	Explanation
TMS > 30 + CBA ≥ 2	GO	The action has a very high threat mitigation score, even though the cost benefit score is relatively low. The action should be pursued through this CMP, as it has such a high potential for environmental benefit.
TMS >15 + CBA ≥ 4	GO	The action has a lower threat mitigation score, with a high cost benefit analysis score. The action should be pursued because it is relatively easy and inexpensive to implement and will still have a moderate to high social or environmental benefit. Some actions in this category have a lower threat mitigation score because they focus on only one threat (e.g. MF1 “Monitor and protect shorebird nesting sites on a yearly basis” had a TMS = 17 and CBA = 7). Such actions should certainly be pursued because of how well they are likely to treat the target threat, and at a high benefit to cost ratio.
TMS <15 + CBA ≤ 2	STOP	The action has a low threat mitigation score and a low CBA score, and therefore should not be pursued.
TMS <15 + CBA ≥ 4 or TMS > 30 + CBA ≤ 2	SLOW, for future consideration	The action falls somewhere in the middle: it has a high threat mitigation score, but is simply too costly or difficult to implement, as described by its low benefit to cost ratio; OR, the action has a very low threat mitigation score meaning it is unlikely to bring substantial environmental or social benefit, even though it may be easy and cheap to implement. These actions are tagged as “SLOW” in that they will not be detailed for implementation through this CMP, but they remain available for consideration, should funding or other assistance permit.

4 Strategy Implementation Plan

(Actions to be implemented by the councils or by public authorities)

Implementation details for the CMP actions are provided in the following sections. The details contained in the tables are explained below.

- **Action ID**: a unique identifier for each action, with the first two letters relating back to the parent management strategy, e.g. Action WQ1 under the parent strategy "Improve Water Quality".
- **Action:** the action name.
- **Details**: further details on how the action should be implemented.
- **Locations**: the sites at which the action should be applied. Where appropriate, the actions have been mapped, to identify the known sites to which an action applies. Actions in the Lake and foreshore area are displayed across 10 maps or zones, as shown in Figure 5-1. The Action Maps are provided in Chapter 5.
- **Indicative costs**: costs have been specified for each action, and for specific elements within an action if known, for example, for sites in the "location" column, or separate items to implement the action. The costs were originally derived from general sources and the Baxter et al (2016) audit, then updated based on the advice of the relevant council departments or agencies where possible. These costs are also outlined in greater detail for the life of the CMP in Chapter 6 (and Table 6-1 in particular).
- **Responsible organisations:** the parties primarily responsible for implementing the action, via financial and other resources, and are listed first (typically this is both Councils).
- **Supporting organisations:** the organisations who may support the responsible party to implement the action, predominately through the provision of technical or project management support, often considered usual business for that organisation, and subject to availability and funding.

  In accordance with the mandatory requirements of the CM Act for CMPs, letters have been received from all state agencies who are responsible and / or supporting organisations for actions in this CMP confirming written agreement to these responsibilities. The letters have been provided to the Minister as a stand alone attachment (they are not required to be in the CMP document).
- **Timeframe:** a timeframe for implementation of parts or all of an action are specified, using time that is equivalent with the key IP&R documents, as follows:
  - Year 1: to match with the Operational Plan (which typically extends for one financial year)
  - Year 2 to 4: to match with the Delivery Program which is a four-year program (including the Operational Plan)
  - Year 5 to 10: to match with the Resourcing Plan which is a 10 year financial plan.
  - The term "ongoing" is used where an action will need to be repeated regularly. Where possible, the details for repeating the option have been included (e.g. yearly, etc)

    - Where possible, the timing of different phases of an action have been specified.

- **Performance Measure**: a measure of the implementation and / or of the success of implementing the action (or parts of the action). Similar language to that used in Councils IP&R documents has been used, to assist with transferring the CMP actions into IP&R documents.
- **Further Information**: supporting documents or information that may assist with implementation are detailed in this column.

It is important to note that in enacting any of the actions in this CMP, all relevant approvals, permits, notifications and licences will be acquired, prior to the works / activities being undertaken (for example, REFs in accordance with the EP&A Act, aboriginal cultural heritage assessments for ground disturbance works, and so on).

In addition to the details provided in the implementation tables,

- The **Business Plan** outlining the costs, cost sharing arrangements and potential **funding** for the actions is detailed in Chapter 6 (and Table 6-1 in particular),
- The **links between actions in this CMP and the IP&R Framework** of both Councils is provided in Section 6.4.

4.1 Improve Water Quality (WQ)

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding and resources)*	Responsibility, Supporting Organisations	Timeframe *(subject to available funding and resources)*	Performance Measure	Further Information / References
WQ1	**Implement a Risk Based Stormwater Management Framework for the Lake Illawarra catchment** • DPIE, in conjunction with both councils, undertake a research project to: o Identify a range of stormwater treatment trains to achieve the new stormwater management targets and reflect contemporary best practices for integrated water cycle management (including a comparison with current or business as usual practices). o Predict life cycle costing of the range of stormwater treatment trains. o Outline opportunities (e.g. riparian corridors) and constraints for siting of stormwater infrastructure o Provide sustainable funding models to assess the viability of the stormwater treatment trains to deliver tailored mechanisms for funding of life cycle costs of assets o Predict (Monetised) co-benefits achieved through contemporary approaches to integrated water cycle management o Develop Step by Step Practice Notes or guidelines on how the *Risk-based Framework* and outcomes of these investigations can be applied to the urban developments in Lake Illawarra.	The Lake Illawarra catchment	$200,000 (DPIE – already funded)	DPIE Supporting: WCC and SCC	Year 1	The project delivers by the end of year one: • A range of stormwater treatment trains to achieve new targets. • Life cycle cost predictions. • Opportunities and constraints for infrastructure sittings. • Sustainable funding models. • Co-benefit predictions. • Implementation guidelines or similar.	Council may consider supplementary funding for the planning of the additional treatment train. Councils encourage the use of alternative and feasible technologies to meet targets. It is recognised that to achieve the best results, the management of quantity as well as quality of water will need to be addressed by developers. For further information refer to Section 2.8.12 of the *Lake Illawarra Information Synthesis Report* (BMT, 2020a). Updating DCP may be delayed by the release of the standard template.
	• WCC and SCC update their DCPs and standard conditions of development consent to reflect the Risk Based Framework pollutant reduction targets as 'best practice' for the Lake Illawarra catchment. See WQ4 regarding implementation.	The Lake Illawarra catchment	$100,000 for temporary staff resource shared across Actions WQ1, WQ2, WQ3 and WQ4, to assist with implementation and managing consultancies (i.e. = $25,000 to this action)	WCC and SCC Supporting: DPIE	Year 1-2	WCC and SCC DCPs are updated by the end of year 1 to reflect the RBF reduction targets. Report on number of DAs submitted with two treatment trains. WCC and SCC make a decision re how to best	
	• Where a comprehensive water cycle management plan is required, developers will be required to provide whole of life costings for treatment trains for both the original targets and the Risk Based Framework targets. Within the trial period (1 year), Council will expect the best overall environmental outcomes within reasonable long term asset management planning.	The Lake Illawarra catchment		WCC and SCC Supporting: DPIE	Year 1-3		

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding and resources)*	Responsibility, Supporting Organisations	Timeframe *(subject to available funding and resources)*	Performance Measure	Further Information / References
	• Outcomes of the DPIE research project and Council trial period will be considered by WCC and SCC to inform future application of the targets under the risk based framework, including whether any further DCP revisions are required.	The Lake Illawarra catchment	Staff time + $20 000 for analysis and report preparation	WCC and SCC	Year 3	implement the RBF by the end of year 3. DCPs updated accordingly where required.	

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding and resources)*	Responsibility, Supporting Organisations	Timeframe *(subject to available funding and resources)*	Performance Measure	Further Information / References
WQ2	**Upgrade existing stormwater quality management measures**, or install new devices, which may include water sensitive urban design or other design that will improve water quality as well as enhance habitat and natural values. Wherever possible and practical, the Risk Based Framework (see further information) should be implemented to determine the design and upgrade to the existing stormwater network. Upgrades and new devices must also be designed to better manage stormwater quantity, such as by reducing flow rates to reduce erosion and damage to vegetation, in an environmentally sensitive manner. • Audit all stormwater quality management devices in the Lake Illawarra catchment, and determine priorities for upgrade or decommissioning. • Prioritisation of new and retrofitting of existing stormwater quality measures to include cost-benefit and assessment of any potential constraints on effective functioning based on full lifecycle operation. • Identify sites for new devices (including locations recommended here). Prioritisation of sites for new devices may be derived from the Benefit Mapping, with the priority areas conveyed by the mapped 'improve' sections of the catchment (Dela-Cruz, et al, 2017, Figure 2-31 in the *Lake Illawarra Information Synthesis Report* (BMT, 2020a). • Set aside adequate funds for continued maintenance of new / replaced devices that accounts for depreciation. • Monitor the effectiveness of various devices in different areas/settings, by monitoring the nutrient and sediment loads after devices are installed or upgraded, and above and below device once installed to test performance. The data may also improve the selection of devices for new or replacement sites. The monitoring should link in with the regular monitoring program given by WQ7. • Incorporate the prioritised program of works into the IP&R Plans. • Increase stormwater filtration by rehabilitating native vegetation & weed removal in stormwater channels, where appropriate and without compounding the risk of flooding.	Catchment wide. Locations for new devices identified in previous studies are: Reddall Reserve – 7 existing devices Whyjuck Bay – 2 existing devices Davies Bay – 1 existing device Karoo Bay – 4 Existing devices Kully Bay Wetlands / Warrawong: new SQID ($55,000) Primbee shoreline (various) Nicolle Road drain exiting Korrungulla Wetlands. Retro fitting of stormwater filtering for N/W Lake i.e. from Berkeley Harbour to Hooka Pt	$100,000 for temporary staff resource shared across Actions WQ1, WQ2, WQ3 and WQ4, to assist with implementation and managing consultancies (i.e. = $25,000 to this action). $60,000 for consultancy to conduct audit across both LGAs and recommend program of works. $10,000 p.a. for monitoring. Upgrades / new devices estimated at $100,000 - $500,000 each, exact numbers and cost of devices to be determined through audit.	WCC, SCC, Individual developers, depending on development. Supporting: DPIE - Coasts & Estuaries, EPA, Property NSW	Year 1: Commence audit Year 2: Complete audit and develop prioritised program of upgrades, new works and decommissioning Years 3 to 10: implement prioritised program of works; and undertake monitoring	• Stormwater audit and renewal program is completed by Year 2. • The prioritised program of works is incorporated into IP&R Plans by Year 3. • Upgrades and new installations commence by Year 4. • Monitoring program for new/upgraded and maintained devices is commenced by Year 4.	The Risk Based Framework = *Risk-based framework for considering waterway health outcomes in strategic land-use planning decisions* (Dela Cruz et al, 2017). DPIE is currently developing waterway health objectives and other tools to support implementation of the Risk Based Framework. Monitoring by WCC at Nicolle Rd Drain has not identified elevated metals in groundwater at end of Nicole Road. Stormwater treatment devices were designed, but not implemented by the LIA.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding and resources)*	Responsibility, Supporting Organisations	Time- frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
WQ3	**Review and prioritise maintenance and cleaning regime for existing stormwater quality devices**, including gross pollutant traps, artificial wetlands and water sensitive urban design features, as informed by actions of WQ2. The maintenance program shall also incorporate any new /upgraded devices implemented through WQ2. Maintenance regimes must also consider efficiencies / new ways to carry out maintenance on specific stormwater quality devices and how the quantity of stormwater can be better managed, to reduce erosion and damage to vegetation from flows from existing stormwater outlets.	All stormwater devices in the catchment, prioritised through review of the program. Known sites include: Reddall Reserve – 6 existing devices, Whyjuck Bay – 4 existing devices Davies Bay – 1 existing device, Karoo Bay – 4 Existing devices Budjong Creek Wetlands Joes Bay Wetland Primbee shoreline	$100,000 for temporary staff resource shared across Actions WQ1, WQ2, WQ3 and WQ4, to assist with implementation and managing consultancies (i.e. = $25,000 to this action). $30,000 for consultancy to review maintenance needs and develop prioritised program. Estimated $5,000 to $10,000 per device p.a. for maintenance and cleaning.	WCC, SCC.	Year 1: Conduct review of maintenance regime and develop program for maintenance. Year 3 to 10: Implement the maintenance program, incorporating new devices as they are installed.	• Review of maintenance regime completed and program of routine maintenance created and adopted by Year 1. • Implementation of the maintenance program is commenced by Year 3.	
WQ4	**Design and implement targeted catchment input monitoring as required for developments resulting in a large-scale change or intensification of land use**. The programs should include monitoring of nutrients and sediments in runoff before, during and after development.	At development sites where there will be a large-scale change or intensification in land use.	$100,000 for temporary staff resource shared across Actions WQ1, WQ2, WQ3 and WQ4, to assist with implementation and managing consultancies (i.e. = $25,000 to this action). Monitoring regimes will be variable and developed on a case-by-case basis	WCC, SCC or Individual developers, depending on development	As required	• Monitoring undertaken for large-scale development projects. • Enforcement occurred where required.	Refer to Section 7.4 for other details regarding monitoring. An example of a large-scale change or intensification of land use for which this action may apply would be the subdivision of a large rural lot for residential development of 50+ lots.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding and resources)*	Responsibility, Supporting Organisations	Time- frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
WQ5	**Reduce sediment load to the Lake by improving compliance with erosion & sediment controls for development sites**. • Increase amount of staff hours spent on reviewing sediment control (plans and on-site). • Increase the number of compliance audits of development sites, which may require additional staff resources. • Audit of sediment and erosion controls to be conducted prior to allowing vegetation clearing and earthworks. • Ongoing audits required throughout the development to ensure sediment and erosion controls are maintained and performing as intended. • Train Council works staff and contractors regarding best practice erosion and sediment control and ensure this is being implemented on Council work sites. • Work with private certifiers to improve knowledge of best practice. Improve auditing and transparency of the application of sediment and erosion controls on privately certified development sites. • Educate land managers on best practice for erosion control.	All new development sites requiring erosion and sediment controls within the Lake's catchment. Includes private and public work sites.	Estimated total of $1.6 million (based on staff resources of $160,000 p.a. for 10 years)	WCC, SCC. Supporting: DPIE - Coasts & Estuaries, EPA, DPI Fisheries.	Ongoing	• Increase in staff hours spent on compliance in the field. Number of development sites inspected and the percentage of sites compliant with best practice. • Number of Council work sites inspected and the percentage of sites compliant with best practice.	Local government officers can inspect any construction site under the power of the NSW Local Government Act 1993 Section 191 Power of entry; and 192 Inspection. There are many examples of successful erosion control programs e.g. Get the Site Right – Parramatta River Catchment Group and Love our Lakes – Bega Valley Shire Council.
WQ6	**Reduce the impact of sewer overflows.** • Develop a collaborative relationship and clarify roles with Councils and Sydney Water to improve gathering and sharing of reports of sewer leaks or overflows (location, severity, frequency). • Improve reporting of leaks and overflows to Sydney Water to assist with prioritising repairs or upgrades. • Identify contacts in Sydney Water and the Councils for record keeping and reporting of leaks and overflows, and sharing of this information as required. • Sydney Water to provide information regarding future upgrade works in the catchment at suitable intervals.	Catchment wide.	Staff time for record keeping and reporting of incidents to/from Sydney Water.	WCC, SCC and Sydney Water Supporting: EPA	Year 1 and ongoing	• 100% of incidents properly recorded and reported to / by Sydney Water.	Sydney Water may need to undertake routine maintenance, emergency work and/ or environmental protection work on their infrastructure which is located in a Coastal Wetland area from time to time to ensure infrastructure is operating effectively and the potential for sewer overflows is minimised. NSW Department of Health are a stakeholder.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding and resources)*	Responsibility, Supporting Organisations	Time- frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
WQ7	**Implement water quality monitoring programs for estuary health, recreational use and physico-chemical and bacteriological indicators in the Lake and its catchment.** Existing **estuary health water quality monitoring** shall be continued, to measure: • temperature; • salinity; • pH; • dissolved oxygen, • turbidity; • total, dissolved and reactive forms of nitrogen and phosphorus; and • chlorophyll *a* **Recreational Use monitoring** should be undertaken in accordance with the NSW Beachwatch sampling protocols. This typically involves sampling for *Enterococci* over the summer period, and as needed on an event-basis. A **catchment wide physico-chemical and bacteriological monitoring** program should be developed to address: • a review of existing monitoring programs; • localised pollution incidents that trigger further investigation; • pre- and post- development indicators; • link to management actions; • link to WQ1; and • inclusion of monitoring locations to account for future development (e.g. Yallah Bay) over time. For all water quality monitoring: • Set up data exchange arrangements with other land managers and use in analysis and annual summaries of results. • An annual summary of monitoring data and analysis of results shall be compiled, with a review of the program and results every 5 years and subsequent changes made if necessary.	Monthly estuary health WQ monitoring at 11 sites (see Section 7.4, Figure 7-1), including: • Lake entrance sites - Site2, Site 3 • Lake edge sites – Site 3A, Site 4, Site 5 and Site 6. • In- lake sites – NS1, NS2, NS3, EW1, EW2 Monitoring of 4 sites for recreational use (BW1, BW2, BW3 and ELL see Section 7.4 Figure 7-1), typically over the summer period. Sites for monitoring in the catchment are to be confirmed. Refer to potential contamination sites, Figure 2-27 in the *Lake Illawarra Information Synthesis Repor*t (BMT, 2020a).	$120,000 / year plus staff costs (time) of $10,000 / year.	WCC on behalf of WCC and SCC, WCC and SCC in catchment Supporting: DPIE - Coasts & Estuaries, NSW Beachwatch Program, and Sydney Water (ELL site)	Year 1 to Year 5, then reviewed, continue Year 6 to 10.	• Annual summary reports completed, displaying monthly monitoring data and analysis of results. • Fiver year review undertaken. • Beachwatch data is collected and available to the public during summer, and as needed, and reported (e.g. in annual summary) as required. • Lake catchment monitoring program is developed. • Lake catchment monitoring is reported annually.	Refer to Section 7.4 for detailed information on existing monitoring programs and details. WCC's program follows standard procedures consistent with the MER protocols (refer Roper et al, 2011). Other specific monitoring actions are outlined without other management actions, such as WQ2. All will be consistent in methodology and linked to provide effective management advice. Action WQ1 may provide guidance on developing a lake catchment monitoring program.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding and resources)*	Responsibility, Supporting Organisations	Time- frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
WQ8	**Improve litter management** through: • provision of extra bins and bin collection in high usage areas over summer, • conducting / supporting clean up days / large scale rubbish removal, e.g. 2 times/year in each LGA such as before and after summer, and • implement a proactive patrolling and compliance program to reduce illegal dumping and rubbish disposal on the lake foreshore, creeks and surrounds.	The Lake and its tributaries, and associated reserves.	$11,000 for provision, servicing and disposal of waste from 20 (10 in SCC and 10 in WCC) extra bins over 13 weeks each summer ($5,500 each for SCC and WCC) $20,000 for 4 (2 in each LGA) large scale clean up events p.a. $10,000 (SCC) and $12,000 (WCC) for additional compliance project costs p.a.	WCC and SCC Supporting: DPIE - Coasts & Estuaries, EPA	Year 1 - 10	• Yearly number of bins /bin collection is increased in high usage areas. • Number of clean up days increased across lake and creeks. • Volume of rubbish collected on clean up days. • Decrease of reported incidents of illegal dumping.	

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding and resources)*	Responsibility, Supporting Organisations	Time- frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
WQ9	**Investigate and manage potential pollution sources including contaminated sites that contribute to poor water quality in the Lake:** • Gather ground and surface water quality monitoring data from active and historical contaminated sites which may have been collected in accordance with EPA Environment Protection Licence conditions, EPA management of Significantly Contaminated Land, EPA/WCC/SCC management of pollution incidents and conditions of consent of Development Applications. • Map the areas of contamination/potential contamination. • Identify data gaps. • Identify which of the areas are currently being managed and which ones there is scope for improved management. • Develop (in consultation with relevant land managers) and implement a ground and/or surface water quality monitoring program targeting potential point source locations, particularly where no historical data is available. • WCC/SCC/EPA undertakes negotiation/enforcement action with site owners for remediation. Any involvement by the EPA would be in accordance with their current legislative responsibilities under the Protection of the Environment Operations Act 1997 and the Contaminated Land Management Act 1997. • Integrate new contamination information with environmental planning and development assessment policy, procedures and tools including DCPs, development assessment procedures, licence agreements, planning certificates and mapping.	Griffins Bay – e.g. from Kemblawarra Industrial area (nutrients and chlorophyll a measured at high levels in Griffins Bay in the past. Metals also possible). Windang Peninsula (from historical uncontrolled emplacement of fill) Haywards Bay (emplacement of fill) Tallawarra Power Station Illawarra Regional Airport (PFAS) Warrawong Tank Trap Woolshed Tannery Refer to potential contamination sites, Figure 2-27 in the *Lake Illawarra Information Synthesis Report* (BMT, 2020a).	$60,000 p.a, plus staff time.	WCC and SCC Supporting: EPA, industries conducting monitoring under licence or other conditions.	Year 2 to 5	• Ground and surface water quality monitoring data is gathered and reviewed • Sources of contamination and sites that are likely to be the source(s) are identified • The EPA / WCC / SCC has commenced negotiations / enforcement actions with site owners for remediation of runoff (in surface and / or groundwater).	Sydney Water has a database of some contamination reports available for the Lake Illawarra area, these reports can be shared with WCC and SCC under a 'Data Sharing Agreement'. It should be noted that the ground water monitoring associated with the Haywards Bay development emplacement did not consider geotechnical issues and the flow path is interrupted by an impermeable/very low permeability high that stops the contaminant from reaching the last test point. Refer to each Councils contaminated land registers; a constraint may be the standard DCP template. Refer to journal article by Jones et al (2019): "Distribution and sources of trace element pollution in the sediments of the industrialised Port Kembla Harbour, New South Wales, Australia".

4.2 Improve Planning and Management Arrangements for the Lake (PM)

(Recommended changes to the relevant planning controls, including proposed maps)

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding and resources)*	Responsibility, Supporting Organisations	Timeframe *(subject to available funding and resources)*	Performance Measure	Further Information / References
PM1	**Commence integration of key objectives and strategies from the CMP into relevant planning and policy documents of both Councils**, including the following actions: • Update the DCPs and relevant consent conditions to specify: – vegetation buffers, stormwater treatment measures and nutrient/sediment load reduction targets for development within the Lake catchment consistent with WQ1; – Coastal hazard management including long term inundation risks (on public and private lands), using relevant controls e.g. foreshore setbacks etc; – the Environmentally Friendly Seawall Guidelines. • Revise LEPs considering CMP management areas and objectives. • Update both Councils' DA checklists to promote preservation of vegetation, erosion and sediment control, management of nutrient and sediment exports, coastal hazards including tidal inundation, and landscaping for new developments. • Update or produce new POMs for community or crown land to include relevant CMP actions / objectives. • Review and update local area plans (e.g. the Windang Town Centre Plan) to include CMP actions and reflect CMP objectives where relevant (e.g. bank protection methods, estuarine vegetation management etc). • Work towards the incorporation of actions into regional and state programs and plans. • Develop Council policies as required to implement CMP objectives and actions. • Provide input to TfNSW when reviewing the NSW Maritime Infrastructure Plan 2019-2024 to have consistency with the proposed Lake Illawarra Waterways Facilities Plan (see RA1) in terms of recreational facilities; and to provide information relevant to speed / usage of boats in key fauna habitat areas. • Provide input to DPI Fisheries when reviewing the commercial fishing status of the Lake regarding benefits or otherwise of commercial fishing being permitted in the Lake. • Continue to support / promote Council submissions to state government on key lake issues e.g. cockle collection, legislation around waffle pods, etc.	Catchment wide	Staff time + consultancy assistance (up to $50,000 per activity).	WCC and SCC Supporting: DPIE - PA, DPIE – Crown Lands, DPIE - Coasts & Estuaries, TfNSW, Sydney Water.	Year 2: DCP and LEP updates Remaining as required	• The DCPs and relevant consent conditions have been revised to include appropriate environmental controls that support Lake health, including the Environmentally Friendly Seawall Guidelines • The LEPs have been revised to consider the CMP objectives and management areas The DA checklists have been revised to include CMP actions and objectives • # of POMs that are revised or produced that cite CMP actions or objectives	Refer to the Illawarra-Shoalhaven Regional Plan

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding and resources)*	Responsibility, Supporting Organisations	Timeframe *(subject to available funding and resources)*	Performance Measure	Further Information / References
PM2	**Provide ongoing coordinated management of the Lake**, which will require ongoing support for existing staff resources, to: • Develop governance model, and where possible, establish this through and MOU with the relevant parties • Undertake the project management of implementing the CMP • Facilitate inclusion of CMP actions into both Councils' IPR Framework documents and business plans • Develop and deliver a resourcing plan to deliver the CMP • Continue to coordinate the Stakeholder Reference Group and foster collaboration with agency stakeholders and recognise the Stakeholder Reference Group as a priority platform for relationship building between all agencies • Compile annual reports on CMP implementation, including checking against performance measures, and reporting against supporting documents • Provide ongoing collaboration between SCC, WCC and other stakeholders on Lake management • Investigate the formation of an Aboriginal Reference Group to support the implementation of the CMP • Establish a grant support fund and support the application of grants including future planning according to Council processes, and • Maintain a successful relationship with the University of Wollongong and utilise student resources where possible.	Catchment and Lake wide	$250,000 p.a.	WCC, SCC. Supporting: Other agencies identified in the CMP, where relevant.	Year 1 and ongoing.	CMP implementation targets are being met on a yearly basis Annual reports on CMP implementation are completed (through the IPR Framework and / or separate report as required) Stakeholder Reference Group meets four times per year.	This action can be linked to PM3 as an avenue to report on outcomes, build relationships, support stakeholder collaboration. The website can be further used for targeted education and marketing, community surveys etc.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Timeframe *(subject to available funding and resources)*	Performance Measure	Further Information / References
PM3	**Develop and implement a community engagement and participation strategy** that enhances the community's knowledge of, skills in, and commitment to, protecting Lake Illawarra. The program should aim to provide information on the ecological, cultural and commercial values of the Lake and to facilitate changes in behaviour of individuals and groups which affect specific threats, e.g. relating to litter and plastics, illegal dumping, species identification and habitat values (saltmarsh, casuarina), cultural heritage. Various avenues for engagement and participation may be used, such as: • Development of a logo and standard design theme for signage for use by both Councils • Interpretive signage at key locations to promote specific lake values / habitats • Media announcements (Newspaper, radio, TV, website) • Brochures • Field Days / Market activities / Workshops • Activities in local schools; school holiday programs • Programs targeting specific interest groups e.g. Aboriginal Community, Bushcare, fishers. • Formation of or support for existing community groups to participate in or undertake activities such as water quality monitoring, estuarine vegetation rehabilitation, passive compliance (e.g. using local residents to monitor and report behaviours such as illegal vehicle access, littering, vegetation damage, illegal fishing, etc) • Support or establish community organised litter collection / clean up events (like Clean Up Australia Day) with Councils collecting and disposing of the litter collected during the events • Promotion of and inclusion in consultation on plans of management affecting the Lake • Regular community surveys to better understand recreational activities, areas used, facilities required, and understanding of environmental issues, e.g. litter, sediments, etc • Monitoring (attendance numbers, changes in behaviour etc) to determine what activities / approaches are successful (and should be continued) or should be modified • Formation and maintenance of a website that outlines the environmental management of Lake Illawarra. • Annual review of community programs and processes.	Sites previously identified as potential locations for signage include: • Hooker Park • Reddall Reserve • Foreshore Area of Davies Bay • Koona Bay • Mogurah Point • Macquarie Rivulet • Purry Burry Point	$80,000 p.a. for a staff member to develop program and $20,000 p.a. to implement program (i.e. for materials, signs, staff and other resources required).	WCC and SCC Supporting: DPIE (including Coasts & Estuaries), ILALC, DPI Fisheries,	Year 1: Develop program Year 2 and on an annual schedule of works: Implement program and monitor success of the different activities	A Community Engagement & Participation strategy specific to the Lake is developed for both Councils Various activities and material / media are completed and prepared on a yearly basis. Surveys and other monitoring activities indicate the success or otherwise of various education activities / approaches.	See also EV3 and PM2 for further education initiatives and collaboration for this CMP. Lake Illawarra Estuarine Education Resource (Meryl McKerrow, 2010) As part of the engagement strategy new and existing platforms should be used including; Let's Chat, Shellharbour Connect, SCC/WCC Council websites and social media platforms. Engagement will include Aboriginal Advisory Committee, Disability Access Inclusion Advisory Committee groups. Landcare may also be involved with this action.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Timeframe *(subject to available funding and resources)*	Performance Measure	Further Information / References
PM4	**Establish a Lake Illawarra Asset Management Working Group** that provides coordination services for agencies that manage assets around the Lake Illawarra foreshore. The working group would: • Oversee the development of a framework for the coordinated management of assets around the Lake Illawarra foreshore, including potential cost sharing arrangements; • Oversee a review of existing infrastructure around the Lake Illawarra foreshore and then an audit to determine priorities and service specifications for maintenance, renewal, additional assets or decommissioning as per action RA1; • Facilitate the inclusion of priorities and service specifications arising from the audit into individual agency asset management plans other IP&R systems and forward planning documents as per RA1; • Provide input into the planning, implementation and reporting of relevant asset management actions within the CMP in accordance to Councils IP&R Framework; • Discuss asset management issues of a cross-jurisdictional nature including joint grant applications; • Provide a forum for improved coordination of the management of assets, for example, the development of a Lake Illawarra Waterways Facilities Plan, an Around the Lake Shared Path as per RA1; or a lake foreshore parks and reserves adaptation plan for tidal inundation (see also IR2); • Provide a forum for exchange of information relating to inundation risk, particularly for forward planning of asset replacement and renewal in areas at risk of tidal or storm event inundation; • Have involvement in the interagency technical working group to oversee management actions in the entrance channel (refer entrance channel area mapped in Figure 5-2); • Produce an accurate and correct map of Lake Illawarra's public land and assets ownership and management.	Whole of lake and foreshore	Working Group $5,000 p.a. to run plus staff time. Development of a Framework $20,000 Other actions are costed in RA1 and IR2	WCC, SCC Supporting: DPIE – Crown Lands, Property NSW, Sydney Water	Year 1: Coordinated Management Framework for Lake Illawarra assets endorsed by members of the Working Group. Year 1: Undertake review and conduct Audit. Year 2: Develop priorities and service specifications for agencies to incorporate into Asset Management Plans and other IP&R documents. Years 2-3: Develop Waterways Facilities Plan. Years 3 to 10: Implement prioritised programs	• The Lake Illawarra Asset Working Group meets at least 4 times a year. Years 1-10. • Joint Management Framework for Lake Illawarra assets endorsed by members of the Working Group by end of year 1. • Review and audit undertaken by end Year 1. • Priorities and service specifications developed by end Year 2. • Agency Asset management plans and other IP&R documents updated by end of Year 3	This action links to RA1 action "manage foreshore and recreational waterway infrastructure", IR1 "Update Asset Management Plans to identify tidal inundation risk timeframes for asset" and IR2 Whole of Lake Foreshore Adaptation Plan.

4.3 Manage the Entrance Channel (EC)

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost * *(subject to available funding, resources)*	Responsibility, Supporting Organisations	Time-frame *	Performance Measure	Further Information / References
EC1	**Investigate and Finalise Options to Manage Erosion and Accretion Changes in the Entrance Channel** Finalise management option study based on assessment of coastal processes driving erosion and accretion in the channel, complete necessary further assessments, detailed design and approvals. Options for managing entrance channel erosion and accretion include: • soft methods such as sand nourishment, dune repairs, dredging of marine sand for reuse on eroded areas or nearby beaches e.g. Warilla; • hard structures e.g. revetments, training walls or groynes; • strategic retreat (e.g. erosion on island foreshore where no assets); or • other options e.g. long term option to constrain channel flow and limit ongoing tidal velocity and tidal prism increase. A range of environmental, social, and economic impacts will be considered in assessing preferred management options, including impacts on cultural heritage. Management options will need to optimise environmental outcomes as well as being technically, economically and socially feasible. An interagency technical working group will be established to oversee the completion of the management options study, the assessment and design of preferred management options and possible funding models for suitable actions. This working group will need to include both councils, TfNSW, DPIE - Coasts & Estuaries, DPIE – Crown Lands, DPI Fisheries.Once agencies agree on preferred management options this action (EC1) will be updated to include the implementation of preferred options. This will require the CMP to be amended and re-submitted for certification. *Note: emergency management and other works that are required to manage public infrastructure before the options study is completed may be undertaken through Action EC3, however there is still a need to consider the impacts of larger scale works in the context of the whole entrance channel.*	**Investigation Area:** Entrance Channel (and adjacent coastal or lake zones as required to inform study). The entrance channel is defined as the area between the eastward margin of the ebb tide delta and western margin of the flood tide delta and adjoining lands. Areas in the channel known to be experiencing erosion or scour: • northern shore of the entrance channel along Windang Foreshore Park and Windang Beach Tourist Park • northern point of Reddall Reserve • channel to north of Reddall Reserve • northern shore of Picnic Island • Bevans Island, Berageree Island, swimming lagoon wall, southern training wall and the base of Windang Bridge piers. Areas in the channel known to be experiencing sedimentation (deposition / accretion): • Flood tide delta • Some sections of channel's southern foreshore (e.g. swimming area at Reddall Reserve)	• Lake entrance management options study: ($500,000, already programmed by WCC). • Detailed design, assessment and approvals of preferred management option/s requiring more immediate response e.g. Windang foreshore protection: $500,000. • Detailed design, assessment, and approvals for possible preferred long-term management option to constrain flow and limit ongoing tidal increases (including cost benefit analysis): $1.0M.	WCC, SCC, DPIE –Crown Lands, DPIE – Coasts & Estuaries, TfNSW Supporting: DPI Fisheries	Year 1: Finalise management options study Year 2-3: Prepare detailed design, assessment, and approvals for the preferred management options.	• Management options study is completed • Interagency technical working group agree on preferred management options .	Emergency management and other works are currently occurring and/or will be required to protect public assets, to ensure public safety / infrastructure projects before the options study is completed. This includes works around Windang Bridge piers, power poles on Picnic Island, sections of the northern foreshore of the entrance channel, and where preferred management actions are already known (e.g. action EC3). Should any preferred action involve dredging of marine sand, and the sand not be required for remediating erosion elsewhere in the channel, SCC would seek to re-use this sand to nourish Warilla Beach (in accordance with the Shellharbour CZMP), with monitoring for effectiveness and adverse / positive effects on surfing conditions and amenity.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
EC2	**Undertake small scale works (e.g. beach scraping, re-shaping etc) to maintain swimming areas**. This action allows for dredging and / or beach scraping/re-shaping to improve the recreational amenity of swimming areas in the channel. This action shall be undertaken so as to avoid direct or indirect negative impacts to or adjacent to the entrance channel.	Swimming areas of Reddall Reserve.	$50,000 - $150,000 per event.	SCC Supporting: DPIE – Crown Lands, TfNSW, DPIE - Coasts & Estuaries, DPI Fisheries	As required	Access and amenity restored to swimming and other waterway amenity areas.	Options study from EC1 to reflect this action.
EC3	**Undertake emergency works or small scale no-regrets actions as required to mitigate known risks to property and public safety**. There are a number of existing at risk areas for which smaller scale actions are needed to mitigate risks to public safety and property in advance of outcomes from EC1. Based on existing scientific and engineering knowledge these actions can be progressed but their impact on the wider entrance channel needs to be considered and addressed. Example actions include: • placing rocks below Windang Bridge piers for stability; • shoreline protection and works to make safe sections of failing existing protection works east of Windang Bridge, northern side (i.e. at Tourist Park); • Endeavour Energy temporary works to protect power poles on Picnic Island; and • Dredging (if / as needed) to manage sedimentation and improve navigability e.g. flood tide delta. If dredging is undertaken: – Reuse dredged marine sand to remediation foreshore erosion / nearby beaches (e.g. Warilla, Perkins); All emergency works actions shall be undertaken so as to avoid direct or indirect negative impacts on the entrance channel and/or adjacent areas.	**Entrance Channel only** such as: • East of Windang Bridge along northern foreshore (e.g. either side of groynes) • Picnic Island (power poles) • Windang Bridge piers, foreshore. • Flood tide delta • Other locations as may arise or be required as emergency works in interim until EC1 is completed.	$0.5M to repair and make safe failing sections of protection works on northern foreshore east of bridge $2.5M for rock placement under bridge piers $150,000 to $2 million per dredging event (noting costs can range from $30,000 to remove 1,500 m^3 from the flood tide delta by excavator to $2M in 2007 for boat-based dredging of 200,000 m^3 from entire entrance and nourishment of Warilla Beach).	WCC, SCC, TfNSW (Windang Bridge), DPIE – Crown Lands (e.g. sections of northern foreshore); Endeavour Energy (power poles on Picnic Island) Supporting: DPIE - Coasts & Estuaries, DPI Fisheries	Year 1- 5, or as required until EC1 is complete	Emergency works / small scale mitigative works are completed in a timely manner in keeping with environmental principles. Any dredging campaigns have had positive outcomes for navigation and for beach nourishment	Links to EC1 and EC4. If the sand is not required for remediating erosion elsewhere in the channel, SCC would seek to re-use this sand to nourish Warilla Beach (in accordance with the Shellharbour CZMP). Further analysis of the longer term impacts and management of Windang Bridge is required and will link to EC1.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
EC4	**Monitor changes to the entrance channel.** Topographic and bathymetric surveys (using ALS or other efficient method) should be undertaken regularly (every 2-5 years) or following a noticeable change, and the data analysed to determine the trajectory of erosion and accretion patterns occurring in the entrance channel (e.g. bank erosion / accretion and channel migration, deepening or filling), since construction of the breakwaters, and in relation to any further structural works. This action will inform EC1.	Entire entrance channel area, from entrance shoals in the surf zone east of the breakwaters to the drop over inside the Lake.	Estimated $10,000 initially then $5,000 every 2-5 years	WCC, SCC Supporting: DPIE - Coasts & Estuaries, DPIE –Crown Lands	Year 1, then every 2 – 5 years or after major storm events	A topographic and bathymetric survey is completed and analysed for changes in the entrance channel at least every 5 years.	Subject to statewide priorities, DPIE can undertake the surveys (subject to resources and other priorities) and share this data with the Councils (and other agencies as needed).
EC5	**Monitor and maintain existing entrance channel infrastructure, with any works to be informed by EC1, EC3 and EC4.** Infrastructure includes but is not limited to: • training works • breakwaters • groynes • revetments.	Entrance Channel	$150,000 - $240,000 pa	DPIE – Crown Lands, Endeavour Energy, TfNSW, WCC, SCC, Supporting: DPI Fisheries and DPIE - Coasts & Estuaries.	Ongoing	Ensure entrance infrastructure is fit for purpose, structurally sound and safe for use.	Note Outcomes of EC1 shall guide any major upgrades to infrastructure, which may be required to ameliorate erosion / accretion impacts etc.

4.4 Protect and Rehabilitate Estuarine and Riparian Vegetation (EV)

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
EV1	**Rehabilitate vegetation and manage public access along foreshores and banks of the Lake, its tributaries, islands and broader low-lying areas**. This shall require: • a site inspection to confirm known and identify new rehabilitation sites; and • prioritisation and preparation of a detailed implementation program and action plan for locations, detailing: – rehabilitation using endemic species, in accordance with best practice, and in line with community values; – weed and pest control in accordance with regional pest plans; – fencing / access restrictions for sensitive areas, with educational signage to explain activities and damage caused by informal access, mowing, tree lopping etc; – permanent public access arrangements, i.e. provision of new / repaired access ways, boardwalks, shared cycleways etc, designed to limit damage to sensitive areas, which may include keeping people on paths; – potential impact on cultural heritage sites associated with degraded habitat and / or rehabilitation works; – Support for and assistance from volunteer Landcare groups (e.g. Budjong Creek Landcare, Bushcare, Aboriginal Bush Regeneration groups. Support includes funding, technical advice, training, and equipment.	Action to cover Lake foreshores, island foreshores, creek banks and broader low-lying areas around the Lake and tributaries, including coastal wetlands and littoral rainforest areas as defined in the State Environmental Planning Policy (Coastal Management) 2018 if required, and including such areas as: • Picnic Island ($10,000); Berageree Island, Pelican View Reserve ($10,000); Bevans Island, Cudgeree Island ($5,000), Hooker Park, Boonerah Point Reserve, Whyjuck Bay. • Karoo Bay, Moureendah Bay, Oaky Creek. • Burroo and Koona Bay, northern bank of Horsley Inlet upstream of Slaters Bridge, Macquarie Rivulet. Shared cost for Horsley, Oaky and Macquarie Rivulet: $65,000 p.a. • Duck Creek (wetlands and riparian corridor, under control of EnergyAustralia); Nijong Bay. • Yallah Bay, Tallawarra Point, Boomberry Point. • Mullet Creek, and Purrah Bay ($500,000, including formal access to reduce uncontrolled damage); Kanahooka foreshore including Brooks Creek. • Fred Finch Park (Hooka Creek, Hooka Point Park and Hooka Creek wetland). • Berkeley Boat Harbour, Tuggerah Bay. • Wollamai Point ($20,000 p.a.); Lake Heights foreshore, Minnegang Creek, Creek adjacent to Kully Bay Oval. • Kully Bay Wetland; Griffins Bay ($200,000, inc. formal access/boardwalk).	Bushland weed control and rehabilitation works typically ~ $2,000-$10,000 per hectare; small scale foreshore access paths typically $5,000 - $20,000.	WCC, SCC; Energy Australia (for their lands only), Property NSW, DPIE – Crown Lands Supporting: NPWS. DPIE - Coasts & Estuaries, DPI Fisheries, LLS, CVA, ILALC, NSW Biodiversity Conservation Trust, TfNSW.	Year 1 and ongoing (new works and / or upkeep)	Number of hectares of estuarine and riparian vegetation managed / protected.	See also the Purry Burry Point to Heritage Park Site Restoration Plan (2013), Berkeley Nature Reserve POM, Picnic Island Reserve POM; Pelican View POM, Boonerah Point Vegetation Management Plan, Judbooley Parade Landscape Master Plan and POM, Generic POM for the Community Land of WCC, and other relevant community or crown land Plans of Management. This action will also benefit water quality as revegetation throughout the catchment reduces

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
	• Continue to fund and implement Council restoration programs in the Lake and catchment. • In conjunction with revegetation works, some bank reshaping and erosion control works may be required, particularly on tributaries and creek banks and foreshores • Support the implementation of the POM for the Berkeley Nature Reserve. • Advocate for appropriate creation of biodiversity stewardship sites and consider possible dedication of biodiversity stewardship sites in the Lake catchment. • Support where appropriate increased conservation outcomes and increased vegetation and biodiversity management actions that are proposed in future biodiversity certification applications in the Lake catchment • Assess parks and sports grounds fringing the Lake for areas suitable for native vegetation. This can increase habitat, connect corridors of vegetation as well as adding shade trees to sports field perimeters. • Action includes all important fringing / riparian vegetation, e.g. Swamp Oak Floodplain Forest, as well as natural vegetated remnants or green spaces with potential to improve natural area connectivity within the catchment.	• Korrungulla Wetland. • Foreshore from Purry Burry Point to Cudgeree Bay, Windang Peninsula. • **Natural Areas Restoration Program** for 3 areas within the WCC LGA: Lake Projects West, North and East ($190,000 p.a. over Years 1 to 3, already committed). • This shall require facilitation of work on private lands. *It is important to note that, while the mapping of this action only shows the tidal portions of creeks and tributaries, the intent of this action is to extend rehabilitation works further upstream to include riparian areas, as this will further improve water filtration of runoff before entering and lake and habitat connectivity.*					sediment run off into waterways. Landcare, MEMA and CVA may also be involved with this action.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding & resources)*	Responsibility, Supporting Organisations	Time-frame *	Performance Measure	Further Information / References
EV2	**Undertake targeted action to control damage to foreshore and lake vegetation, including seagrasses,** caused by: • 4WDs and other vehicles, • bikes (including BMX), • boating activities, • unfenced stock, • mowing practices, • tree damage and removal, • pedestrians, • illegal structures (e.g. land reclamation, seawalls, boat ramps, BBQs, seating, fencing, private signage), • hand gathering (e.g. cockles etc). Actions may include: • Prioritise and prepare detailed implementation program for mapped locations. • Bollards / fencing / gates etc to restrict illegal access (provided they are low key from a visual perspective). • Signs to explain estuarine habitat values. • Signs / other barrier to replace removed vegetation. • Removal of illegal structures (in consultation with landowners). • Improved surveillance and compliance (through additional staff resources). • Develop a policy for mowing practices on public foreshore lands, and educate Council works staff regarding the policy. • Monitor the success of the different approaches for reducing access and damage and modify future approaches accordingly. • Managing impacts on cultural heritage sites from vegetation damage and / or access. • This may include negotiating voluntary acquisition of critical lands with sensitive habitats.	Action is relevant lake wide, with known areas outlined below. • Foreshore between Jettys by the Lake and Oaklands Village, Windang • Whyjuck Bay • Mogurah Point, and Yangar Point (restrict access to reduce vegetation clearing, mowing and excessive access, Oak Flats foreshore, Davies Bay and Karoo Bay. • Koona Bay (south eastern side), Burroo Bay, Kurrura Point. • Macquarie Rivulet coastal wetlands (CM SEPP) area (issues with cattle, 4WDs and other vehicles); Koonawarra Bay • Brooks Creek Delta (southern end, issues with bike jumps and other activities). • Koonawarra Bay (North), Purrah Bay. • Hooka Creek, Hooka Point and Berkeley foreshore. • Park east of Wollamai Point • Primbee Bay (BBQs, ramps, seats), Griffins Bay. • Purry Burry Point saltmarsh community (issues with 4WDs), and foreshore southward to Windang Note: there may be new areas identified in the future where similar rehabilitation works need to occur, consistent with best practice and that have minimal disturbance, e.g. in the coastal wetlands and littoral rainforest areas. Tidal inundation may increase the prevalence of illegal / ad hoc structures where foreshore areas are being slowly and permanently reduced in size.	Depending on physical barrier selected, cost may range from $10,000 to $100,000. Additional staff resources for compliance $80,000 p.a. (shared across both councils).	WCC, SCC Supporting: DPI Fisheries, DPIE – Crown Lands, DPIE - Coasts & Estuaries, TfNSW, LLS.	Year 1 and ongoing	Number of hectares of vegetation managed (on private and public land) and number of illegal activities investigated.	See also the Purry Burry Point to Heritage Park Site Restoration Plan (2013), Berkeley Nature Reserve POM, Picnic Island Reserve POM; Pelican View POM, Boonerah Point Vegetation Management Plan, Judbooley Parade Landscape Master Plan and POM, Generic POM for the Community Land of WCC, and other relevant community or crown land Plans of Management. Target areas: where problems have occurred; and where new view conflicts may arise due to mangrove growth (see medium priority areas from Williams and Wiecek, 2017). MEMA may be involved with this action.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
EV3	**Prepare and deliver an information program for the Lake Catchment** on: • mowing and gardening around sensitive foreshore vegetation; • the legalities of building of structures (BBQs, seating, boat ramps, seawalls, land reclamation, fences, etc); • environmentally friendly designs, habitat rehabilitation options, and planning and approval requirements for foreshore structures and works; • illegal access and dumping; • the importance of undertaking appropriate and ongoing Pest and Weed Management activities; • threatened flora and fauna species, migratory birds and EECs that the Lake supports, • vegetation damage and removal; and • cultural heritage. Information can include: • the importance of estuarine vegetation for ecological function, bank protection and water quality; • the natural increase in mangroves in the Lake since lake opening; • surveillance and reporting methods and prosecution / fines for offences. Activities could include • Identifying Lake users associated with threatening activities that have a representative organisation or individual, or another means through which they can be reached as a group, with aim to facilitate partnerships to increase community engagement & participation. • Develop partnerships that aim for understanding of community needs & use negotiation to reach agreement. • Field days, brochures, workshops, and signage at relevant locations. • Training for Council staff. Audiences may include: • foreshore land owners, council works staff, landscapers/ builders, and via high schools and general community. • DA officers and building certifiers etc. who approve or design foreshore works (for education regarding foreshore structures).	Catchment wide.	$20,000 to develop program, plus $10,000 p.a. for staff time and resources to implement.	WCC, SCC. Supporting: DPIE - Coasts & Estuaries, CVA, LLS, DPI Fisheries, TfNSW, ILALC.	Year 1 and ongoing	Information program is developed by end Year 2 and incorporated into PM3. At least 2 successful partnerships established annually with Lake user groups & relevant activities / programs developed & delivered through those groups.	This action links with PM3. Target areas: where problems have occurred; and where new view conflicts may arise due to mangrove growth (see medium priority areas from Williams and Wiecek, 2017, reproduced in Appendix E of the *Lake Illawarra Information Synthesis Report* (BMT, 2020a)). Council/ other organisations Communication Policies. Lake Illawarra Estuary Management Education Program. Developed by WCC and Dep't of Education 2010. Ocean Watch, Landcare and CVA may also be involved with this action.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding and resources)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
EV4	**Prepare and implement an estuarine macrophyte mapping and monitoring program**. • Undertake estuarine macrophyte mapping for the entire lake, to determine the current coverage and distribution of mangroves, saltmarsh and seagrass. • Determine changes in distribution and coverage of macrophytes, by a comparison with the previous mapping. • Monitor areas identified as high and medium priority for conservation of saltmarsh in foreshore prioritisation maps (see Appendix E of the *Lake Illawarra Information Synthesis Report* (BMT, 2020a) and Figure 7-2) for 2 years. If it can be shown mangroves are having an impact on saltmarsh, work with relevant stakeholders to determine best strategies to minimise ongoing impacts and develop a mangrove management plan if necessary. • Repeat lake wide estuarine macrophyte mapping and analysis every 5 years.	Lake wide. For comparison of mangroves and saltmarsh, focus on Medium and High Priority areas identified in the Foreshore Prioritisation Maps (as per mapping by Williams and Wiecek (2017), in Appendix E of the *Lake Illawarra Information Synthesis Report* (BMT, 2020a); and Figure 7-2).	$50,000 per mapping episode (Year1, Year 6 and Year 10). $10,000 for area specific macrophyte monitoring (Year 2-5).	WCC, SCC Supporting: DPIE - Coasts & Estuaries, DPI Fisheries, Energy Australia	Year 1: mapping Year 2 to 4: monitoring Year 6: mapping Year 10: mapping	Estuarine macrophyte mapping and analysis completed by Year 2. Area specific monitoring completed by Year 4. Estuarine macrophyte mapping and analysis repeated by Year 6 and Year 10.	Some estuarine macrophyte mapping is already being undertaken by stakeholders. EV4 is not intended to duplicate any existing work; rather this action is intended to promote stakeholders working together to best use resources to gain the appropriate information required by all for use. This action links with EV5. Refer to guidance in *Assessing estuary ecosystem health: Sampling, data analysis and reporting protocols* (State of NSW and OEH, 2016). DPI Fisheries has recently completed some mapping of estuarine vegetation within Lake Illawarra, and will be examining trends in marine vegetation distribution to date as part of a MEM Strategy project.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding and resources)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
EV5	**Develop and implement a program to enhance opportunities for estuarine vegetation migration**. • Build on previous work to identify areas that could be modified or managed to permit migration and colonisation by saltmarsh. Previous work is illustrated in Appendix E of the *Lake Illawarra Information Synthesis Report* (BMT, 2020a)) with respect to tidal inundation projections, as a starting point of priority areas. • From EV4, add areas where action is required to manage saltmarsh retreat. • Implement actions to allow saltmarsh migration or manage retreat, e.g. by: land repurchase (as one example of how this action could be undertaken, and which does not rule out the other ways to implement the migration plan), MOUs with landowners, removal of physical barriers (e.g. walls, paths, land reclamation).	Potential areas for migration are identified in the Foreshore Prioritisation Maps, based Williams and Wiecek (2017) in Appendix E of the *Lake Illawarra Information Synthesis Report* (BMT, 2020a).	Staff time or consultancy ($25,000) to develop and progress action program to achieve security of migration areas into the future. Additional $ to implement actions.	WCC, SCC. Supporting: DPIE - Coasts & Estuaries, DPI Fisheries, DPIE – PA.	Year 2 to 10	Areas are identified and program is prepared by end Year 5. Number of locations where modifications have been made to promote migration or manage retreat.	This action links to / follows on from EV4. Refer to Section 7.4.7, and recommendations by Williams and Wiecek (2017). MEMA may also be involved with this action.

4.5 Maintain and Improve Recreation and Amenity (RA)

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
RA1	**Manage foreshore and waterway recreational infrastructure** in accordance with Transport and Recreation Asset Management Plans, condition assessments and asset management strategies prepared by relevant agencies, informed by Plans of Management and approved recreation masterplans. 1. Prepare in consultation with TfNSW, the Lake Illawarra Waterways Facilities Plan that prioritises boating facility upgrades based on factors including but not limited to user demand, existing facilities and available navigational access. 2. Undertake a review of existing information on recreational infrastructure (i.e. established hierarchies, recommendations from maintenance programs for existing facilities, user needs now and into the future with population growth, tidal inundation (see IR1) etc, ownership and responsibility (connection with IR2), entrance channel issues (see EC actions), costs and other resources) and prepare a comprehensive audit and risk assessment to inform next actions (upgrades, renewals, replacements, strategic retreat, decommissioning etc). 3. Consider the provision of additional facilities during the audit (e.g. BBQs, picnic shelters, drinking water stations, toilets, fitness equipment, fish cleaning stations, lighting, dog bags, BMX / skate parks etc). 4. Establish service specifications for priority existing foreshore assets for inclusion in Agency and Council asset management plans and other IP&R documents based on the audit, including ongoing maintenance, upgrades / renewal, replacement, additions to or decommissioning of existing assets. 5. Develop priorities for new assets and improved assets to be incorporated into relevant WCC, SCC, Property NSW and DPIE – Crown Lands planning documents for future budget consideration. 6. Upgrades, maintenance and new infrastructure should be designed to be: • environmentally and fish friendly; and • Wheelchair / disability accessible.	**Works currently programmed include:** • Koona Street Stormwater renewal (20/21) $250,000 • Central Park play equipment (19/20) $200,000 • Reddall Reserve park and boat ramp renewal ($1.2m in 2019/20 plus some construction in 20/21) • Deakin Reserve building and carpark renewal (20/21) • Lake Cycleway renewal: Lake Heights to Berkeley Boat Harbour ($120,000) • Primbee to Windang: Shared path renewal along Windang Road ($100,000) Future work locations are to be determined by the audit (2) and Lake Illawarra Waterways Facilities Plan (1).	Maintenance: $5,000 per item for an estimated 25 sites p.a. (total of $125,000 p.a.) Programmed upgrades of $1.87+ million. Independent audit / condition assessments: $60,000 ($20,000 to DPIE – Crown Lands and $40,000 to WCC/SCC). Lake Illawarra Waterway Facilities Plan: $50,000. Future upgrades and costs will be determined after the audit is completed.	WCC, SCC, DPIE – Crown Lands, Property NSW (in lands that they own and manage) Supporting: TfNSW, DPI Fisheries	Year 1-2: Undertake review and conduct Audit. Year 2-3: Develop prioritised program. Incorporate into forward planning documents, existing Asset Management Plans and other IP&R documents. Years 2-3: develop Facilities Plan. Years 4 to 10: Implement prioritised program and asset management plans.	Review and audit undertaken by end Year 2. Prioritised program developed and incorporate new assets into planning documents by end Year 3. Asset management plans and other IP&R documents updated by end of Year 3 Boating Plan for Lake Illawarra developed by end Year 3. Prioritised Program and asset management plans are implemented by end Year 10. Yearly maintenance of assets is under-taken.	Ownership of some land and assets around Lake Illawarra is fragmented. Refer to Land Tenure map for current status of land ownership and responsibility for this action This action links to action PM4 “Establish a Lake Illawarra Asset Management Working Group” and IR1 “Update Asset Management Plans to identify tidal inundation risk timeframes for asset”. TfNSW may also need to be involved in this action. Links to EC actions

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
RA2	**Construct new sections of shared pathway to complete the pathway linkage around the Lake.** • Remove and rehabilitate informal / degraded tracks as new sections are completed. • Consider disabled access and facilities, bubblers / drinking stations, and lighting when designing new shared pathway sections. • The shared pathway will not be extended through sensitive environmental and / or cultural areas and its siting will accommodate current and future site constraints including tidal inundation. • Consultation will occur with all appropriate landowners in negotiating the preferred route.	**Works currently programmed include:** • Feasibility and constraints mapping for an Around the Lake Shared Path Plan ($120,000). • Koona Bay (future stages, design $50,000; Kanahooka St to Shearwater Blvd likely on-road construction $350,000) *Note: location not mapped as preferred siting for this path is yet to be determined.* Listed below (but not mapped) are locations for shared paths requested by the community for future consideration, but that are not currently in SCC or WCC Infrastructure Delivery Programs: • *Community request a shared pathway link from Macquarie Rivulet to Tallawarra Power Station (so that cyclists do not need to use the highway with 100km speed limit). As part of this, investigate providing shared pathway to Haywards Bay.* • *Kanahooka Point to Purrah Bay;* • *Shared path bridge over Mullet Creek, from Purrah Bay to Currungoba Peninsula* • *Currungoba Peninsula / Koong Burry Bay foreshore, linking to Hooka Park and crossing of Hooka Creek.*	Programmed works: $520,000. Future works are estimated at $100,000 to $1,000,000 per path including design costs, depending on style and length.	WCC, SCC, Private Developers through s94 provisions. Supporting: DPIE – Crown Lands, TfNSW, DPI Fisheries, Property NSW	Year 2: develop Around the Lake Shared Path study. Year 1 to 10: implement upgrades and extensions to cycleway.	Pathway alignments determined by end Year 2. Prioritised program for new path construction developed by Year 3.	While formal access paths will also be constructed through action EV1, sites listed under this action and RA2 are primarily for community and recreational use. This action links to RA3 – public right of way.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
RA3	**Investigate the opportunities of public access along the foreshore and amend the acquisition layers of the relevant Council Local Environmental Plans if applicable.** As part of development applications or rezoning proposals, negotiate with land owners regarding public and private foreshore ownership and allow public access along private foreshore sections as opportunities present themselves.	Apply to areas as appropriate.	Staff time	WCC and SCC Supporting: DPIE – Crown Lands, DPIE-Coasts & Estuaries	Year 5 to 10	Length (m) of foreshore where public access is achieved.	Some properties are already designated for acquisition, specific to the Wollongong LEP. Linked to RA2 and objectives around improving public access to the foreshore.
RA4	**Build on the Tourism opportunities for Lake Illawarra** Encourage Destination Wollongong and Tourism Shellharbour to work together to further develop and achieve common Tourism goals across the lake. This includes linking the outcomes of the CMP to the Destination Management Plan – Wollongong and Destination Management Plan – Shellharbour. Recognising that a healthy lake underpins expanded but sustainable tourism based infrastructure and activities.	Whole of lake	Staff time	WCC, SCC Supporting: Destination Wollongong, Tourism Shellharbour	When the Destination Management Plans for Wollongong and Shellharbour are updated.	The revised Destination Management Plans for Wollongong and Shellharbour are linked to the CMP. The revised Destination Management Plans for Wollongong and Shellharbour have a specific Lake Illawarra component and that they have appropriate links to each other, recognising the shared nature of the asset.	Destination Management Plan - Wollongong Destination Management Plan-Shellharbour 2018 – 2022
RA5	**Conduct small scale dredging to improve public recreational outcomes and to improve the functionality of stormwater outlet infrastructure.** Allow for localised dredging around key recreational boating infrastructure and stormwater drains around the Lake where sedimentation and/or the changed nature of the entrance channel has impacted on usage, access and/or functionality. Dredging to be supported by clear justification of the recreational and functionality need, consideration of any cumulative environmental impacts as well as all required environmental assessments and approvals.	Lake wide. Potential locations for small scale dredging include limited areas in proximity to public recreational facilities, assets and infrastructure including boat ramps, jetties and sailing clubs; and stormwater drains.	$50,000 - $300,000per episode. *Note: if a dredging episode is costed at more than $300,000 (at 2020 prices) it should not be considered small scale for the purposes of this action, and should be investigated through action RA6.*	SCC, WCC Supporting: DPIE – Crown Lands, DPIE – Coasts & Estuaries, TfNSW, DPI Fisheries	Opportunistic, as funding becomes available and as need becomes apparent.	Small scale dredging undertaken with all required environmental controls and approvals to improve recreational use and/ or functionality with minimal environmental impact.	Funding is currently available for one-off dredging projects that result in improved navigation and recreational outcomes under the Rescuing our Waterways Program from DPIE – Crown Lands.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
RA6	**Investigate the need for and viability of larger scale dredging of bays and the entrances to creeks or other measures to improve recreational amenity and access within the Lake where sedimentation and/or the changed nature of the entrance channel has negatively impacted on recreational use.** The investigation would include but not be limited to the following. • A business case considering broad social, economic and environmental implications and consideration of all possible alternatives. • An identification of the parameters and limitations of the activities being proposed including a consideration of government policies and an indication of the likely approval pathway and the type of environmental assessment that will be required. This may be an environmental impact assessment which evaluates; impacts on aquatic ecosystems and hydrological regimes, the mobilisation of contaminants and associated health impacts, treatment of potential or actual acid sulphate soil, and sediment reuse. • The investigation will recommend specific actions, and a cost-benefit analysis which includes full lifecycle management considerations must be completed for recommended actions. • Upon completion of the RA6 investigation, this CMP may need to be amended to include any recommended actions to undertake dredging at identified locations. Resubmission and recertification of the CMP would be required before any dredging could occur.	Whole of lake but concentrating on bays identified during public consultation including: • Griffins Bay • Southern Back Channel • Buroo Bay • Koona Bay • Haywards Bay • Koonawarra Bay • Purrah Bay • Koong-Burry Bay • Tuggerah Bay • Entrances to creeks	$300,000 for investigations.	SCC, WCC Supporting: DPIE – Crown Lands, DPIE - Coasts & Estuaries, TfNSW, DPI Fisheries	By year 6	Investigation completed that includes specific actions, a Business Case, Environmental Assessment and Cost Benefit Analysis	If the investigation showed larger scale dredging was appropriate and viable the anticipated costs per episode would likely be $1M-$5M.

4.6 Protect and Promote Cultural Heritage (CH)

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
CH1	**Protect and promote cultural heritage in and around the Lake and its catchment.** Employ a Cultural Heritage Officer to work on Lake Illawarra with assistance from Federal or State funding processes. This person will work with the Aboriginal and non-indigenous community to further cultural awareness activities, such as: • Develop and implement a Conservation Management Plan for Lake Illawarra to achieve conservation and protection of Aboriginal heritage sites recognised as being at risk. Protection of eroding heritage sites is also captured by Action FB1. • Undertake a strategic review of foreshore infrastructure to consider the heritage and cultural significance of sites such as the Tank Trap and Dix's Wharf. • Support trials in cultural burning, assisting in monitoring and evaluation and supporting follow up reporting of outcomes. • Build cultural links with other strategies when implementing the CMP. This could include education materials, signage, provision of facilities, rehabilitation works, etc. • Encourage suitable cultural tourism ventures in and around the Lake. • Implement the re-naming / shared naming of sites of cultural significance around Lake Illawarra to name of relevant Aboriginal origin. • Organise a 'festival of the Lake' event that celebrates the areas cultural and ecological values. • Develop an Illawarra Events Strategy which integrates compulsory cultural recognition of the Lake and its values into key community events. • Support the continuation of the Lake Illawarra Arts Trial around the entire lake foreshore. • Encourage signage recognising the indigenous history of relevant sites.	Lake wide	$100,000 p.a. for additional staff resource. $20,000 p.a. for operating costs. Costs for heritage protection works included with FB1.	WCC, SCC Supporting: NPWS, DPIE - Coasts & Estuaries, ILALC, LLS.	Year 1 and ongoing		Dance hall on Gooseberry Island (managed by NPWS under the Berkeley Nature Reserve Plan of Management) is an example of a non-indigenous heritage site. Unknown what heritage protection works will be required over the 10 year life of the plan, therefore costings for this have not been included in the business plan. Fire and Rescue and RFS may also need to be involved with this action. This action links to PM3.

4.7 Manage Foreshore and Bank Erosion and Sedimentation (FB)

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
FB1	**Undertake a bank condition assessment and determine and implement erosion control measures.** • Undertake a bank condition assessment of lake and tributaries to the tidal limit (and beyond if resourcing allows) to map foreshores experiencing erosion. • Identify the likely causes of erosion (e.g. stormwater outflow, wind waves, tidal currents). • Prioritise the sites based on their severity, risks from ongoing erosion (e.g. to public safety, nearby seagrasses etc), and feasibility and cost of controlling erosion / management action. • Determine feasible and appropriate erosion control measure that also optimise environmental outcomes. • Concept designs for remedial action should preference the use of revegetation, or otherwise utilise the environmentally friendly seawall guidelines for engineered solutions and aim to improve habitat connectivity and protection of cultural heritage. Potential disturbance of cultural heritage needs also be considered in designs. • Monitor success or otherwise of remedial action. • Provide bank condition assessment and outcomes to relevant land management authorities including DPIE – Crown Lands to assist them in managing their assets.	A bank condition survey of entire Lake foreshore and tributary creeks to the tidal limit is required to identify current sites of erosion (see actions details and further information). *While it is noted that foreshores are variously in public and private ownership, identifying all sites allows state agencies to work with private land owners to achieve consistent remediation outcomes.*	$60,000 for consultancy for bank condition assessment (allocation of $5,000 to DPIE – Crown Lands and $55,000 to WCC/SCC) (survey, identification of causes, prioritisation and erosion control recommend-ations). $5,000 p.a. for monitoring. $20,000 to $200,000 per site for erosion control works, depending on requirements.	WCC, SCC Supporting: DPIE - Coasts & Estuaries, DPIE – Crown Lands, DPI Fisheries, LLS	Year 1: Conduct bank condition assessment Year 2 onwards: begin implementing erosion control works. Monitor low risk sites for change in erosion risks. Year 3 and ongoing: monitor effectiveness of erosion control measures.	Bank condition assessment and report is completed by Year 1. # of sites where erosion control is implemented. # of sites where monitoring demonstrates remedial works are effective.	Due to the lapse of time and the focus on using revegetation to manage many erosion issues (see EV1), the mapping by OEH and LIA of eroding sites is no longer current, and therefore requires updating. The bank condition survey could be teamed with Action FB3, depending on time constraints and methods used. DPIE – Crown Lands will be considering future requirements for bank stabilisation works for Oaklands Village and Jetties By The Lake – this will be incorporated into a strategy with any future works as yet, un-funded.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
FB2	**Implement Environmentally Friendly Seawall Guidelines or similar for new and upgraded foreshore protection works.** This action aims to improve the environmental performance and outcomes for foreshore protection works when the renewal of existing or construction of new infrastructure is required, where appropriate and feasible to do so. The Environmentally Friendly Seawall Guidelines or similar should be used in upgrade designs, to improve the environmental benefits of existing structures.	All applicable Lake foreshore areas where proposals exist for new or upgraded seawalls. This may include: • Oaklands Village to Jettys by the Lake. • Skiway Park • Illawarra Yacht Club structures	$50,000 to $150,000 per site, depending on requirements.	WCC, SCC, DPIE – Crown Lands, other land owners / managers Supporting: DPIE - Coasts & Estuaries, DPI Fisheries	Year 2 onwards	# of sites upgraded by Year 5.	EC1 will provide information for the entrance channel.
FB3	**Undertake a bathymetric survey of the entire Lake and tributaries up to the tidal limit.** Survey should be conducted along transects used previously in the tributary creeks. Methods such as marine-based LiDAR should be considered. Survey should be compared with previous surveys, to determine if and where sedimentation / erosion is occurring on the Lake or creek bed. Survey to be completed every 10 – 20 years. Senior Management Team in both Councils to be informed when complete.	Entire Lake waterbody and all tributary creeks up to the tidal limit (Future surveys can capture beyond the tidal limit).	$50,000	WCC, SCC Supporting: DPIE - Coasts & Estuaries	Year 5	A whole of lake and tributary bathymetric survey has been completed and analysed against historical data	

4.8 Prepare for Inundation Risks (IR)

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
IR1	**Update Asset Management Plans for all publicly owned and managed assets to clearly identify asset at risk from inundation over future timeframes, including tidal inundation.** This involves notation of the risk of periodic and permanent inundation on asset management registers for roads, stormwater infrastructure, sewer and water infrastructure, community facilities including parks and reserves, cycleways, jetties, boat ramps, entrance training walls and other waterway infrastructure, environmental assets such as saltmarsh, coastal wetlands, etc. When asset managers progress a refurbishment or replacement of the asset, the inundation risk can then be factored into the redesign / relocation / alternatives of the asset. The asset management plan notation should trigger an options assessment for replacement or major upgrade, to determine a preferred approach that manages inundation risk as well as improving the asset. Novel solutions to relocate, raise or retrofit the asset should be considered. The feasibility and viability of asset relocation including impacts upon upstream and surrounding land need to be investigated. The assessment should identify an inundation response that is suitable to the expected lifespan of the asset and its interdependencies with other assets. Consideration of asset interdependencies should link back to strategic planning, floodplain risk planning and/or adaptation plans for the region. For example, raising of a roadway will need to consider both the servicing of residents and the effect of road raising on flood/inundation behaviour. Asset management plan updates should incorporate findings of Action IR2, when available. Asset management is an important vehicle for implementing adaptation actions in a cost effective and timely manner. Implementing replacement or retrofit actions to manage inundation at the time of asset renewal avoids both the costs of not fulfilling the asset life before inundation reaches an unacceptable level, or the potential costs of maladaptation where action is taken too early. Frequent inundation of assets, such as roads, buildings etc.is also costly in terms of wear and tear and clean up. This action is also a key avenue for capturing asset maintenance activities or refurbishments that are exempt from planning controls or approvals.	All assets affected by tidal inundation over future timeframes (refer Asset Risk Registers and Risk Maps in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b).	Staff time (or $10,000 per agency / council for minor consultancy) to update asset management plans.	WCC, SCC, DPIE – Crown Lands, Property NSW, Sydney Water, TfNSW, DPIE - Coasts & Estuaries Supporting: DPI Fisheries	Year 2-4	All agency asset management plans are updated	The extent and risks from tidal inundation are in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b) and Kumbier et al (2019) tidal inundation modelling report. This action links to Action IR2 Whole of Lake Foreshore Adaptation Plan and Action IR5 Investigate novel solutions to manage inundation risks to assets. Property NSW is in the process of upgrading Strategic Asset Management Plans for all assets within the Kully Bay locality.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
IR2	**Prepare a whole of Lake Foreshore Adaptation Plan for public (community and environmental) lands**, which will involve adaptation planning for all foreshore parks and reserves, including their associated assets such as cycleways, jetties, boat ramps, to provide a holistic approach to managing and adapting to tidal inundation risks. The action involves assessment and selection of adaptation actions for parks /reserves around the entire Lake Illawarra foreshore, considering tidal inundation and current and future usage demand, to determine: • parklands that are more resilient, or can be reconfigured to retain their useability over time; • parklands that are feasible to protect; • land areas that will need to be transitioned from open space to fringing habitat; • land that needs to be secured for future relocation of larger assets such as the cycleway, • land that needs to be secured for future foreshore and wetland habitat migration (linking with Action EV5); • a program of asset raising for jetties and boat ramps (which by their very nature need to be next to or in the waterway) provided access to the asset can be maintained. Outcomes of the adaptation plan should then be fed into masterplans / POMs for the parks, to facilitate implementation of adaptation actions. As required, the outcomes of this action could also be fed into asset management plans (see Action IR1). This action requires collaboration and consolidation for managing foreshore community / recreational and environmental lands, which can be facilitated through Action PM4 Establish a Lake Illawarra Asset Management Working Group. This action aims to recognise that tidal inundation has a very different and detrimental consequence on community recreation reserves and assets compared with storm inundation because it is effectively permanent, with the community losing access and enjoyment of precious and rare foreshore land.	All parks, reserves, sports grounds, and associated assets, particularly those with high usage / demand including but not limited to: Reddall Reserve Fred Finch Park (inc. sports grounds) Shared Path / Cycleway (entire lake) Judbooley Parade Foreshore Windang Foreshore Hooka Park Skiway Park Koona Bay Reserve Koonawarra Bay Lakeside Drive Reserve William Beach Reserve Lake Illawarra Foreshore	$80,000 for an adaptation plan for the park and reserve network around the Lake. Incorporating outcomes into POMs / Masterplans to occur as and when they are updated. Incorporating outcomes into Assets Management Plans to occur through existing costings for Action IR1.	WCC, SCC, and Property NSW. Supporting: DPIE – Crown Lands, DPIE-Coasts & Estuaries, DPI Fisheries, TfNSW.	Year 5 -7	An adaptation plan has been prepared. POMs / Masterplans and asset management plans incorporate findings of the plan when they are updated.	The extent and risks from tidal inundation are contained in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b) and Kumbier et al (2019) tidal inundation modelling report.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
IR3	**Incorporate tidal inundation mapping into strategic land use planning documents.** As a minimum this would include a foreshore building line / buffer / setback in the LEPs, DCPs and council policy. Tidal inundation risks are different to storm inundation risks in that the tidal inundation water level occurs so frequently as to be considered permanent (e.g. daily high tides), and the existing land use can no longer be supported. This is a different impact than for storm events where the inundation occurs very infrequently (once in 20 years+) and many land uses can continue between events. And in this case, land use planning controls for flooding will not fully manage tidal inundation risks, and additional controls are needed. The planning controls would apply to both public and private land to enable the continued provision of: • public right of way and access to the foreshore, • land for fringing habitats, and • new public assets on community land and infrastructure (i.e. that would not be in existing asset management plans). Areas that are impacted by inundation should not be eligible for land use intensification.	All land affected by tidal inundation.	$20,000 for consultancy to develop foreshore building line and other appropriate controls. Staff time to implement.	WCC and SCC Supporting: DPIE – PA, DPIE - Coasts & Estuaries	Year 2 to 4	Planning controls have been amended to include appropriate provision for tidal inundation	Land affected by tidal inundation is illustrated in the Kumbier et al (2019) tidal inundation modelling report.
IR4	**Undertake water level and condition monitoring for all lake inundation events** (i.e. tidal, ocean anomaly, rainfall), to: • Record the frequency and details of events, based on review of existing lake water level gauge data; • Record assets affected and impacts / condition after each event or yearly, as required; and • Report to Council and update asset management plans as required. Asset condition monitoring should prioritise public foreshore assets that are expensive, have a long lifespan, and / or are highly important to the community, include natural assets. This action provides invaluable information to demonstrate the occurrence of coastal inundation, and for developing triggers for site specific management actions into the future.	Key foreshore assets following inundation events including “king high tides” and ocean water level anomaly events.	$10,000 p.a. for water level and asset condition monitoring;	WCC and SCC Supporting: DPIE - Coasts & Estuaries	Year 1 and ongoing	Water level recording is maintained. Asset condition impacts after inundation events is recorded and used in AMPs	The extent and risks from tidal inundation are contained in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b) and Kumbier et al (2019) tidal inundation modelling report.

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
IR5	**Investigate novel solutions to manage inundation risks to assets such as stormwater, sewer, and water; cycleways, roads and bridges, etc.** This action aims to provide novel and innovative solutions to asset replacement where relocation is not viable. Certain assets by their very nature must be located on low-lying high risk lands, for example sewer and water pump stations and stormwater outlets. This action would involve: • Literature review identifying the latest technologies and success of their implementation worldwide; • Challenges and opportunities defining the viability of solutions in the Lake Illawarra context, including physical processes of inundation in the Lake and interdependencies and connectedness of assets; • Research and development of novel solutions, for example – Bunding around pump stations, – Floating cycleways / roads / arterial roads, – Bridge designs that allow for habitat migration, – Stormwater pump systems and backflow devices, – Legalities and practicalities of handover/ acquisition / repurchase of private land to council / state once permanently inundated; and • Recommendations for suitable solutions and / or further research / case studies in the Lake Illawarra context.	Whole of lake	$30,000 plus partnership (i.e. in-kind contribution or ARC grant) with a private consultancy and/or research organisation to fund for example a PhD or post doctorate position.	WCC and SCC Supporting: DPIE - Coasts & Estuaries, Sydney Water, TfNSW.	Years 5-10	A report is produced (e.g. PhD thesis, post-doctoral thesis, scientific report etc) on viable novel solutions to inundation risks for asset replacement specific to Lake Illawarra.	

4.9 Protect and Manage Key Fauna (MF)

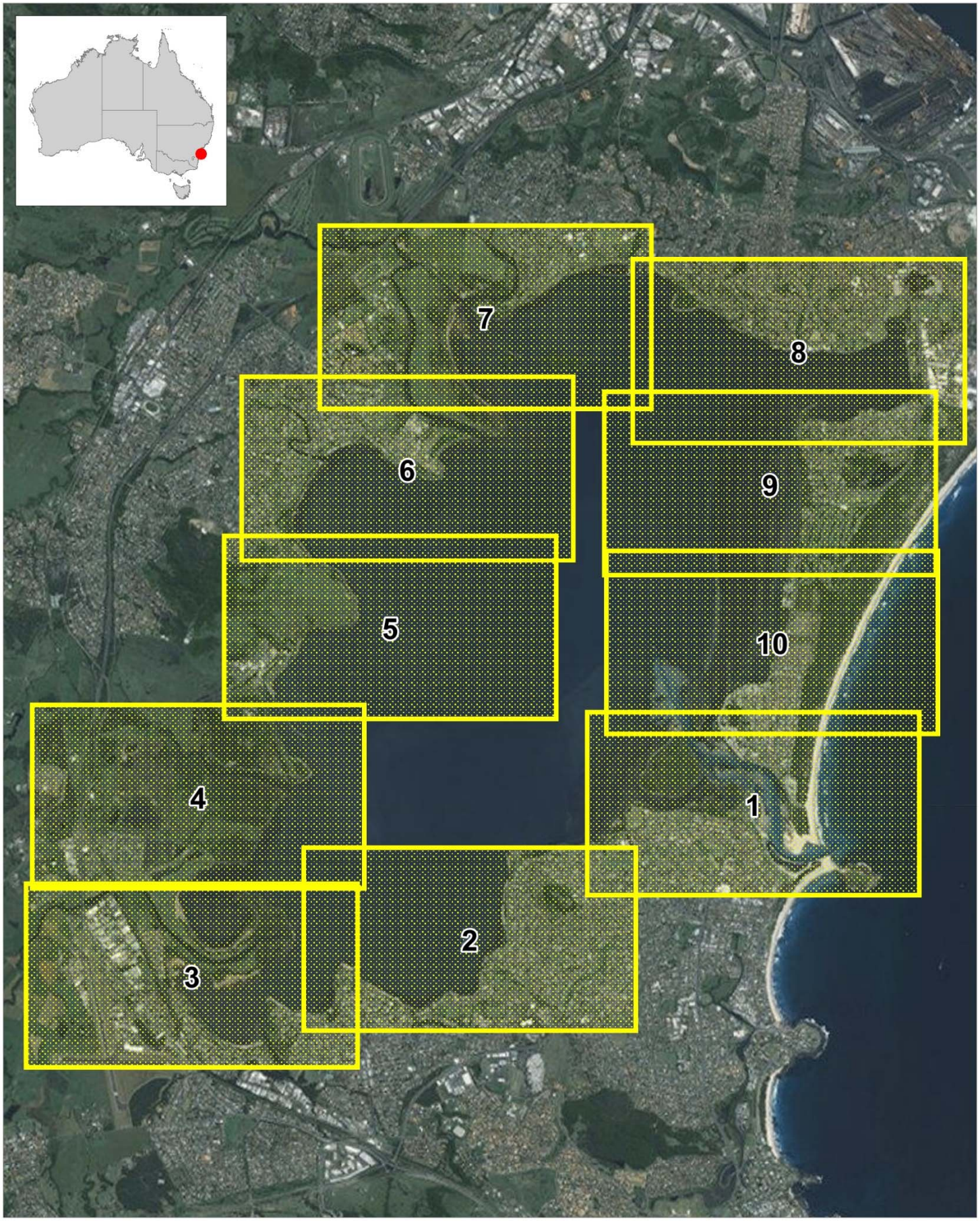
Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations / Programs	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
MF1	**Develop and implement a fauna management program including shorebirds fish and other fauna**. This may include but is not limited to the following actions where Council works with stakeholders to: • Identify, monitor and protect shorebird habitat, foraging, breeding and nesting sites on a yearly basis (refer to Figure 2-20, pp. 52 of the *Lake Illawarra Information Synthesis Report* (BMT, 2020a)) and assist DPIE - Coasts & Estuaries /NPWS in managing the public through education and exclusion works, and / or pest management (e.g. fox control) that may be required; • Where appropriate, rezone bird habitat areas to higher environmental protection zones (including to national park status where supported by NPWS); • Survey recreational fishers on a regular basis (e.g. every 5 years), to gather data on fish species distribution and numbers in the Lake. • Undertake periodic scientific fauna surveys (e.g. every 2-3 years) to better understand fish and other fauna assemblages, distribution and numbers in the Lake. • Advocate for and investigate conducting a study on cockle biomass, to assess for the sustainability of cockle harvesting in the Lake and assist in the development of a harvest strategy for the species. • Analyse the data sources (i.e. recreational fishers, fauna surveys, commercial fishing data) to identify trends in fauna assemblages. • Where a change or impact on fauna health is identified, determine causes and develop and implement actions to mitigate the change / impacts, where possible. • Councils to assist in distribution of agency education material concerning fishing and fauna management.	Lake Wide, including: • Entrance Channel (various, as nesting sites change year to year)	$15,000 to develop fauna management program. $50,000 for staff and resources to implement actions, e.g. shorebird habitat monitoring, recreational fishing surveys, data management. $20,000 (consultancy) per ecological survey and analysis.	WCC, SCC. Supporting: DPIE - Coasts & Estuaries, LLS, DPI Fisheries, TfNSW, local businesses to support survey distribution where appropriate.	Year 1 and ongoing	Fauna management program is developed by end Year 2. Number of successful shorebird hatchlings per year. Number of recreational fishing surveys returned. Number of scientific fish and fauna surveys undertaken Data sources (e.g. surveys above) are reviewed to identify any trends at the completion of each survey event	Links to education programs in PM3 and EV3. Local bird clubs could be engaged to help do counts e.g. Illawarra Birders whom already do regular bird counts at various Lake Illawarra sites and share information with agencies. Refer to survey method guidance in *Assessing estuary ecosystem health: Sampling, data analysis and reporting protocols* (State of NSW and OEH, 2016). Protection of fauna is done under the general biosecurity duty obligations of the *Biosecurity Act 2015.*

5 Action Maps

The following chapter contains a series of maps covering the entire foreshore region of the Lake and displaying locations for CMP actions where applicable. A key plan displaying the coverage of each map is provided in Figure 5-1 as an overview to the zone maps.

The Action maps display the known locations for which various actions in the CMP shall be applied and should be read in conjunction with the implementation details provided in Chapter 4.

Not all actions have been mapped, only those actions for which mapping is useful or relevant (e.g. Action PM1 is not mapped as it is not location specific and applies catchment wide, whereas specific areas known to require rehabilitation through action EV1 have been mapped). Not all locations at which an action may apply have been mapped, as new or unknown locations may arise over the life of the plan (for example, there may be new rehabilitation areas identified in future for action under EV1). In addition, in relation to rehabilitating riparian habitats (EV1), the mapping has focused on the immediate Lake foreshore and tidal sections of tributaries. However, it is the intent of this action to extend beyond the tidal limit of tributaries where works will have a benefit on reducing pollutant loads entering the Lake.



Title:

Lake Illawarra Management Actions - Map Key

Figure: **5-1**

Rev: **A**

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Approx. Scale

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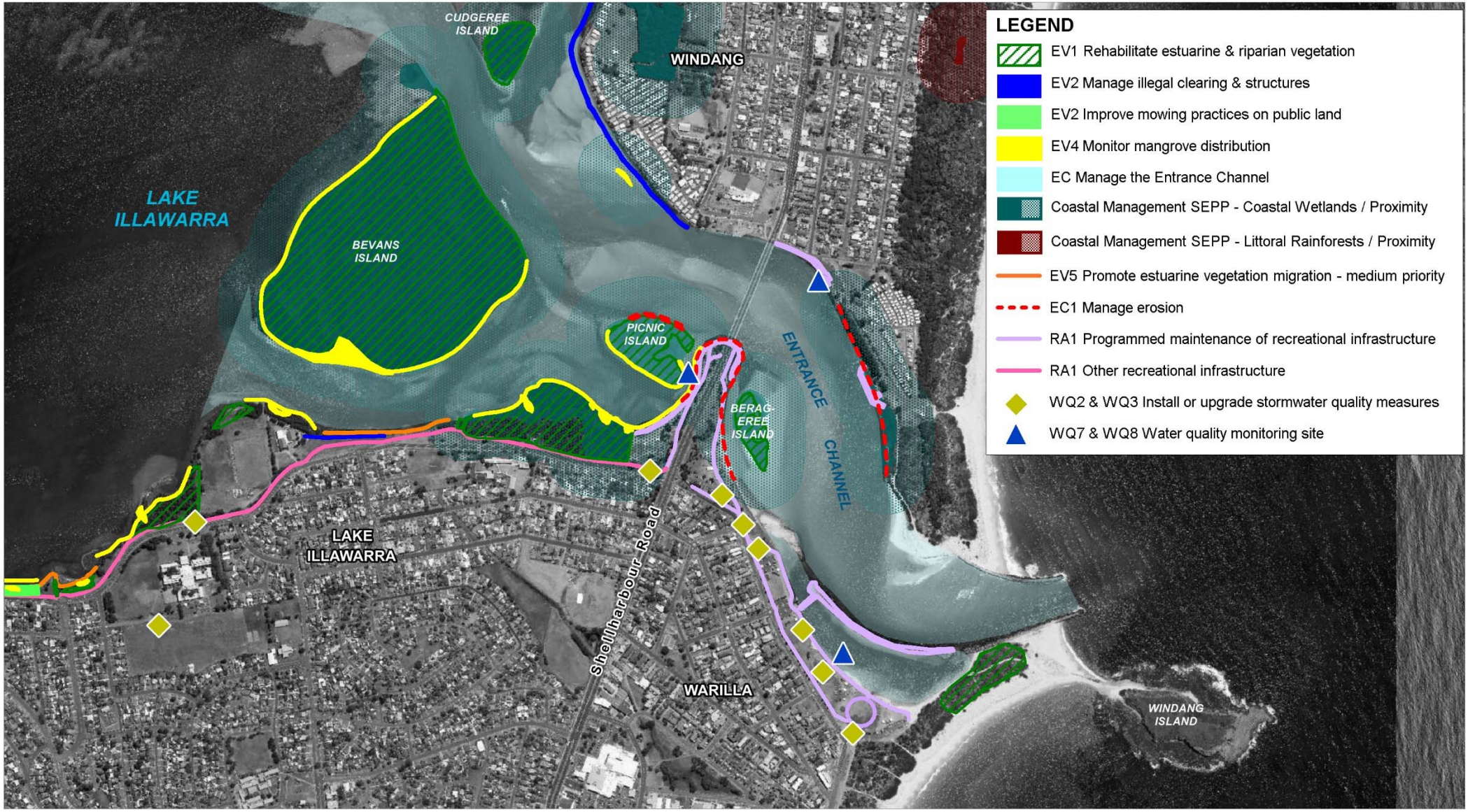

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Lake Illawarra Management Actions - Zone 1

Figure: **5-2**

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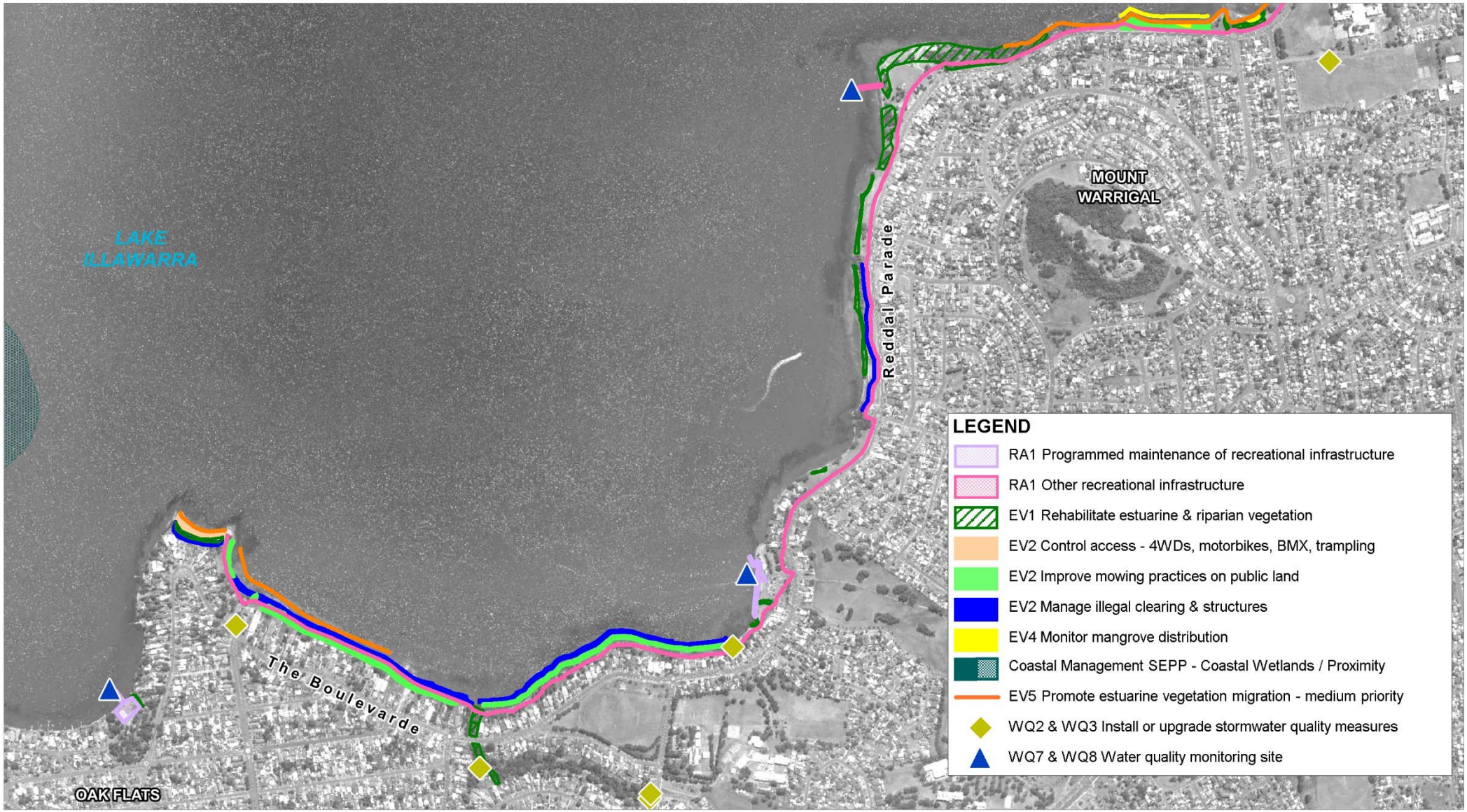

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Lake Illawarra Management Actions - Zone 2

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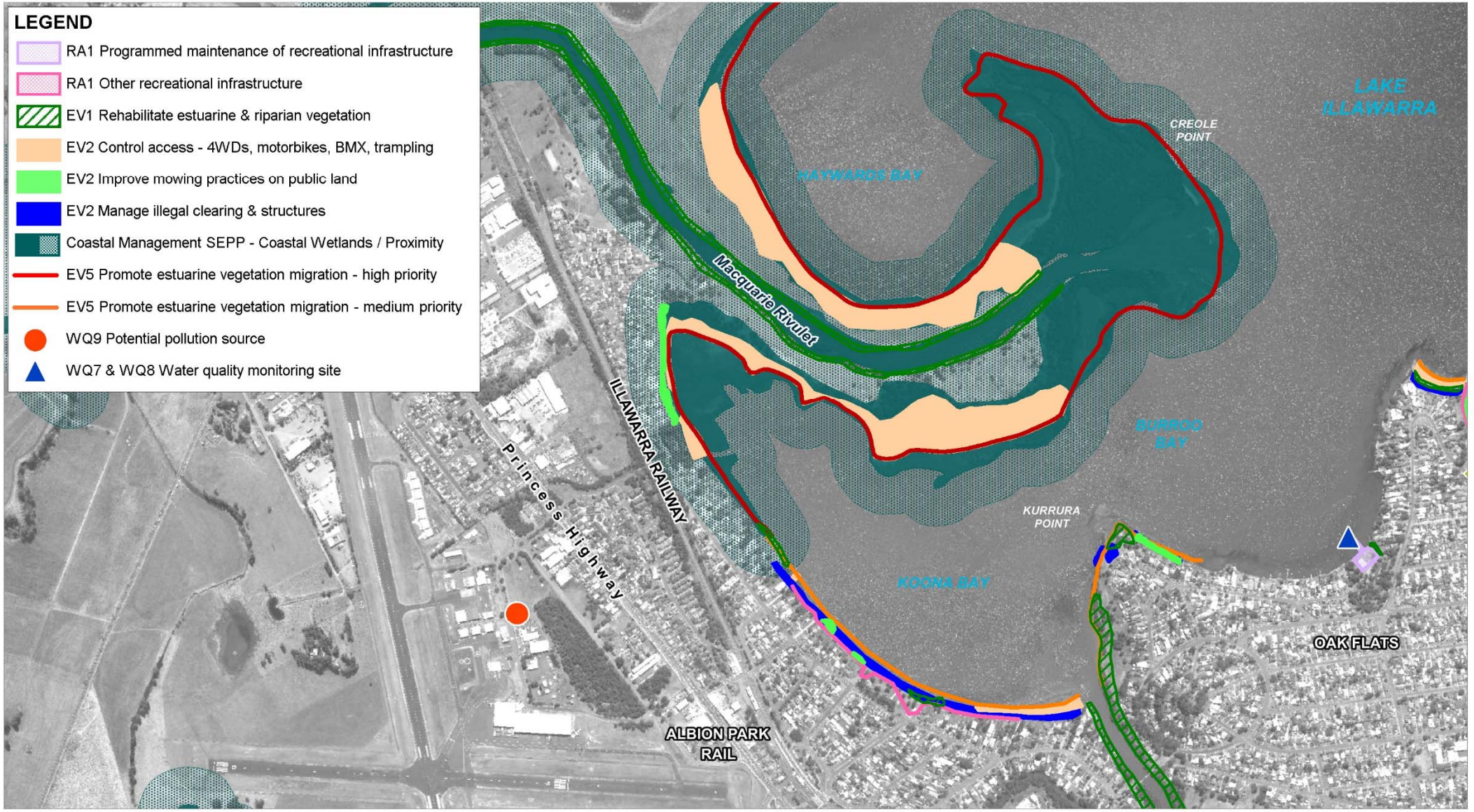

Title:

Lake Illawarra Management Actions - Zone 3

Figure: 5-4

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Title:

Lake Illawarra Management Actions - Zone 4

Figure: **5-5**

Rev: **C**

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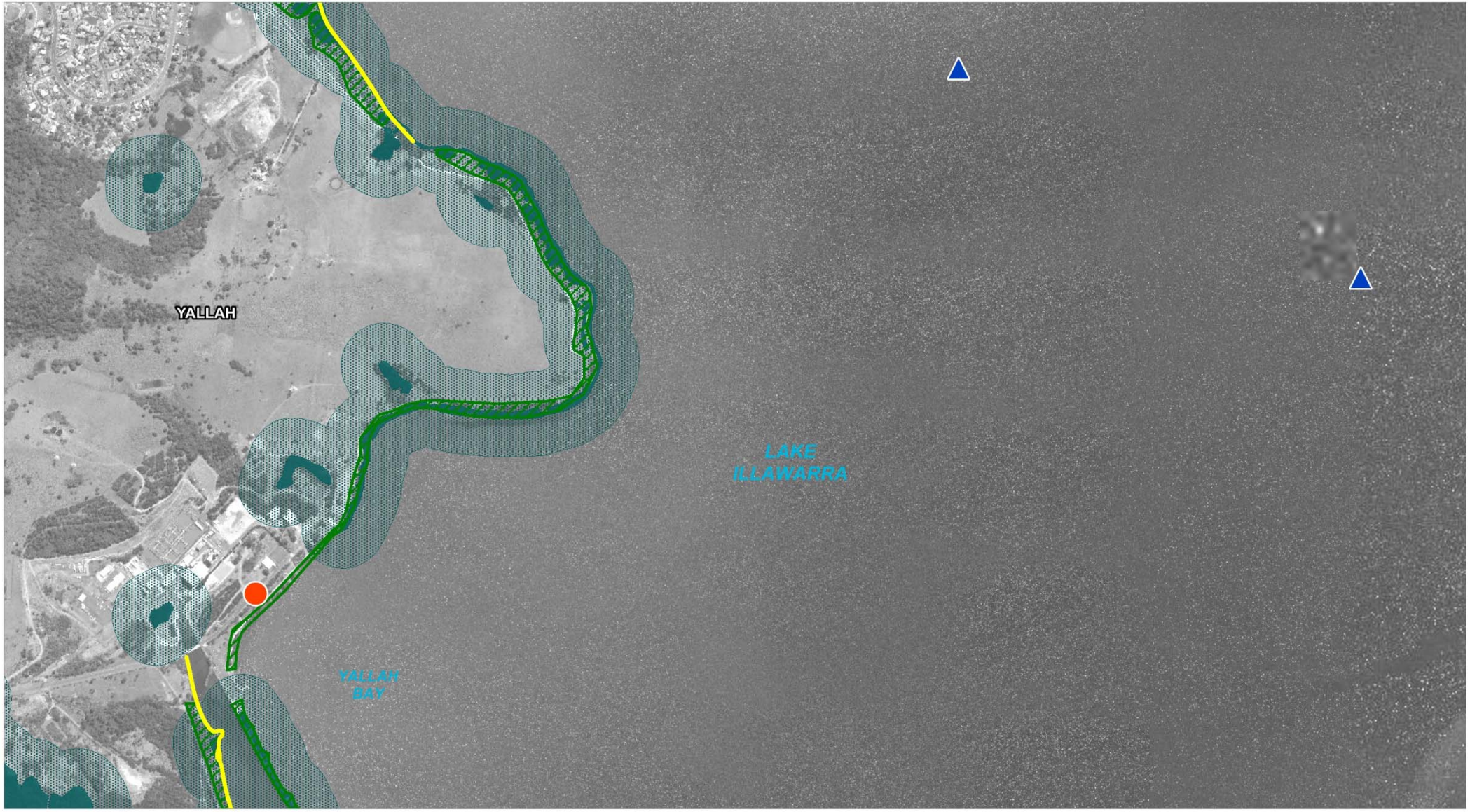

LEGEND

- EV1 Rehabilitate estuarine & riparian vegetation
- EV4 Monitor mangrove distribution
- Coastal Management SEPP - Coastal Wetlands / Proximity
- WQ9 Potential pollution source
- WQ7 & WQ8 Water quality monitoring site

Title:

Lake Illawarra Management Actions - Zone 5

Figure: **5-6**

Rev: **C**

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Approx. Scale

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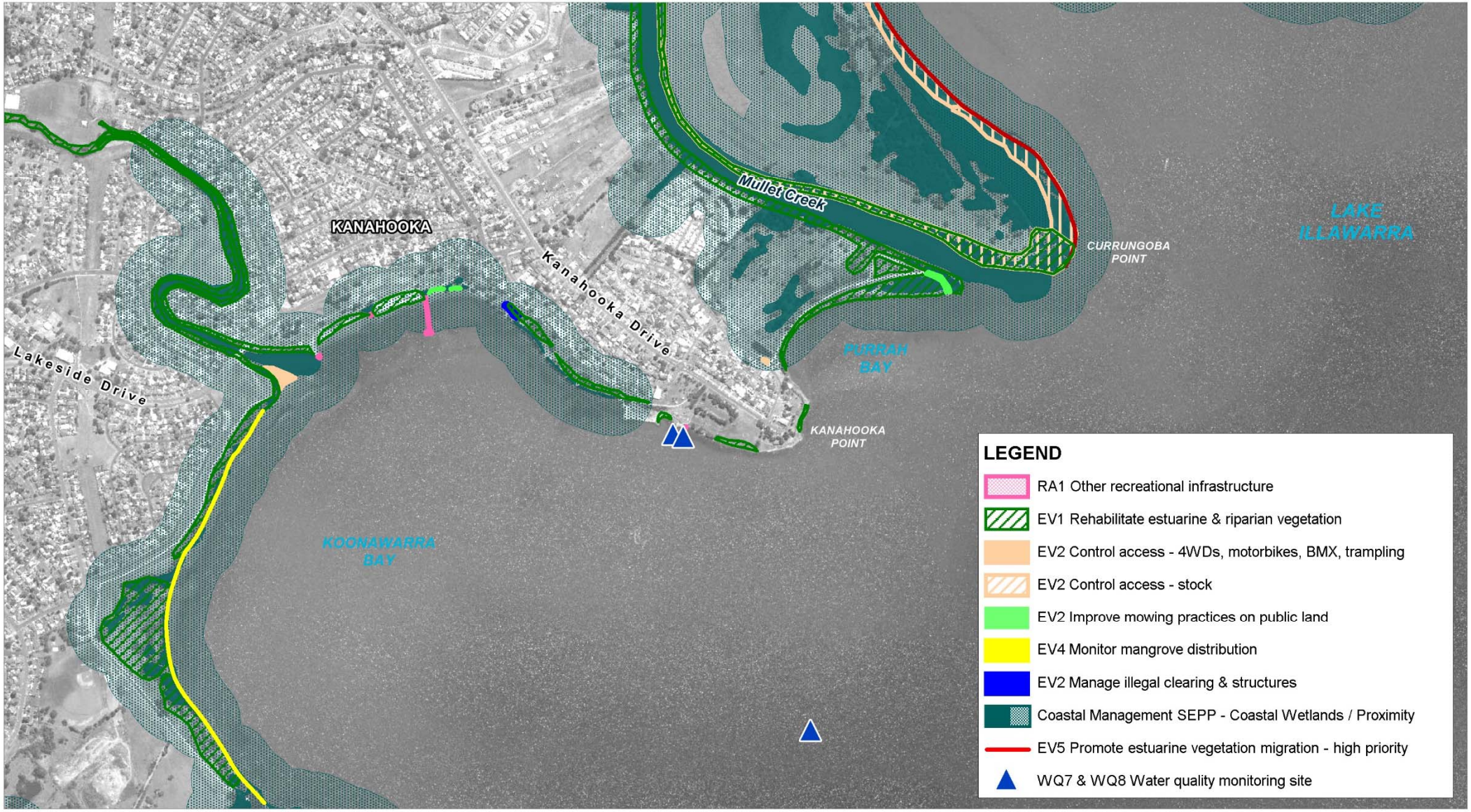

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Lake Illawarra Management Actions - Zone 6

Figure: **5-7**

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Approx. Scale

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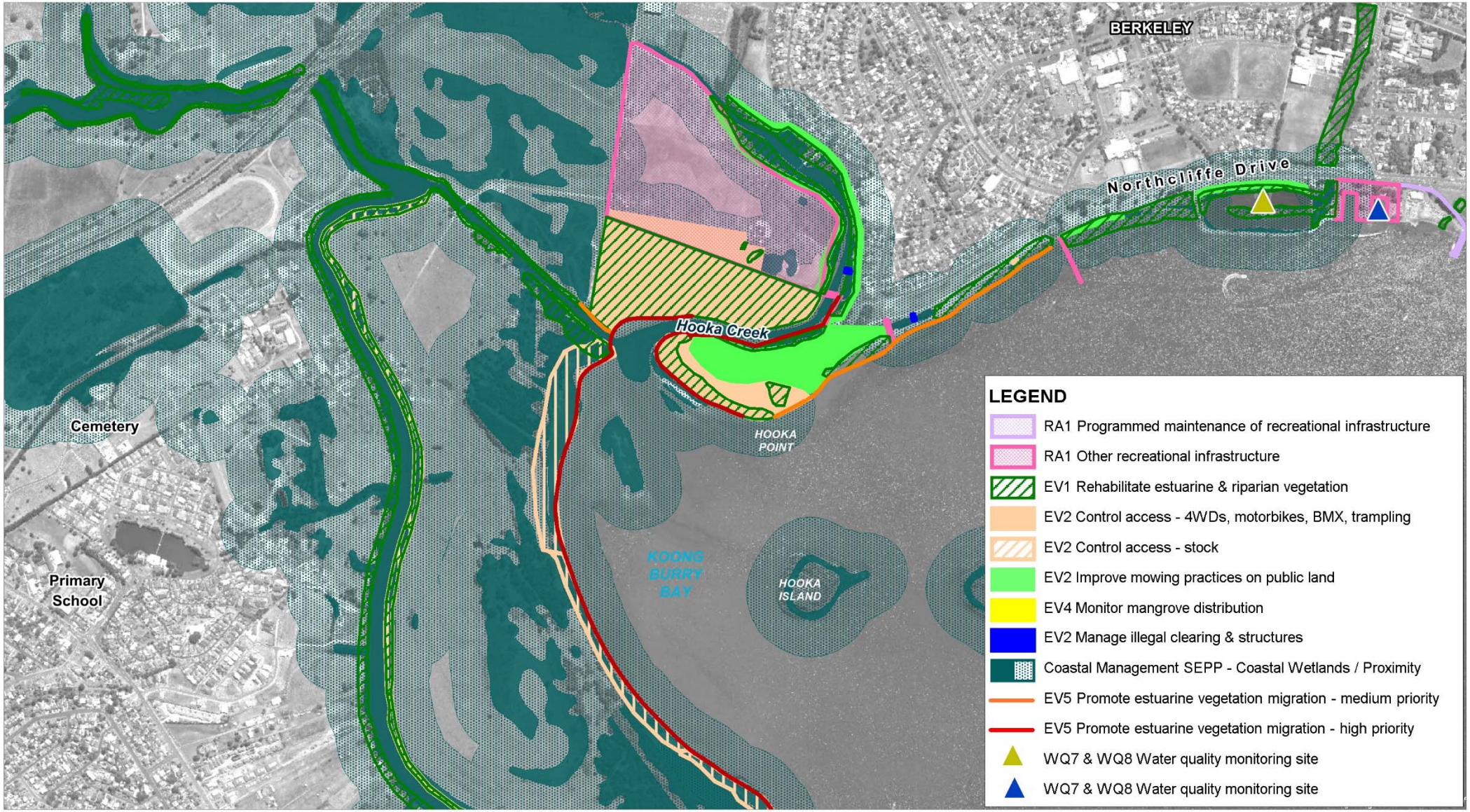

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Lake Illawarra Management Actions - Zone 7

Figure: **5-8**

Rev: **C**

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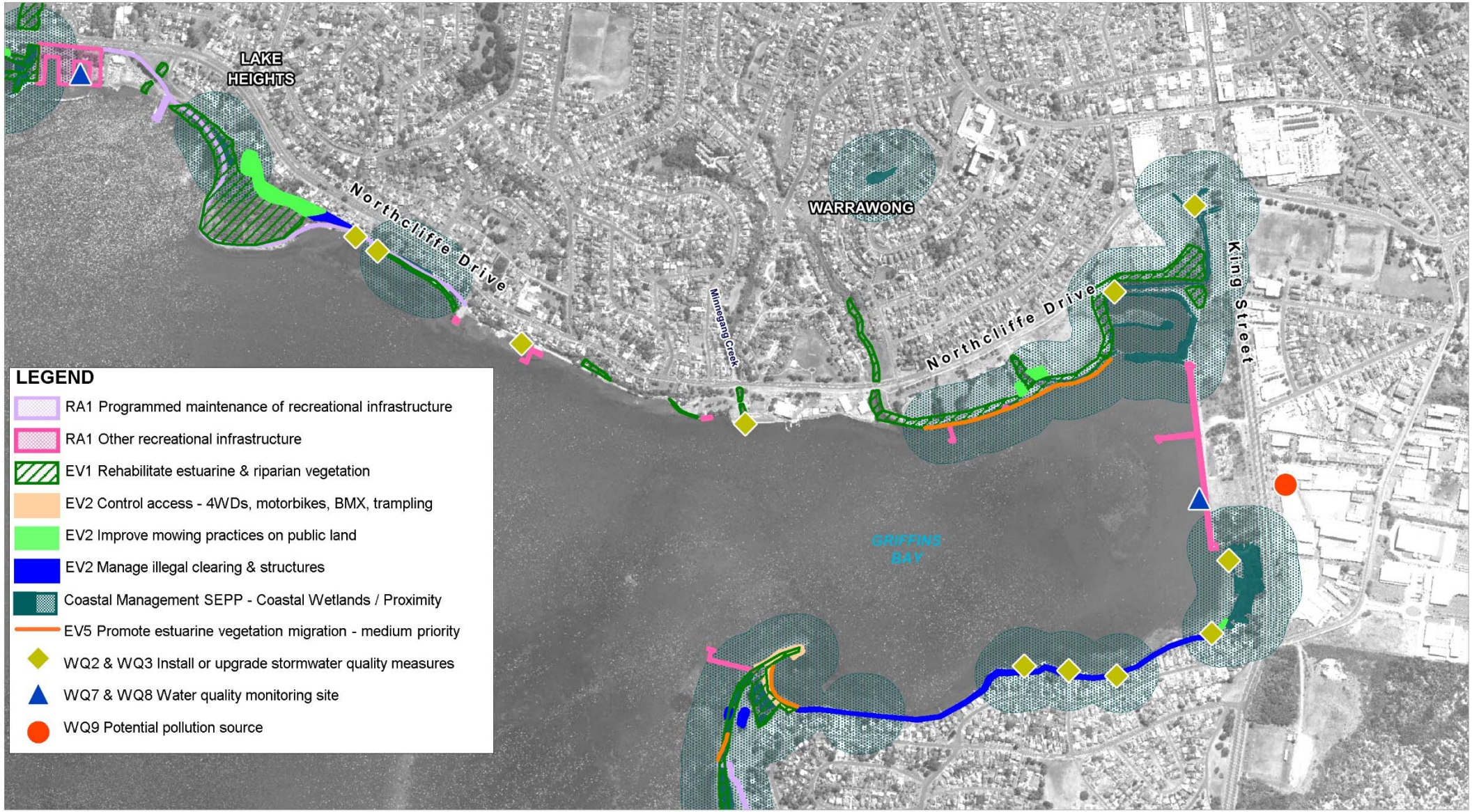

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Lake Illawarra Management Actions - Zone 8

Figure: **5-9**

Rev: **C**

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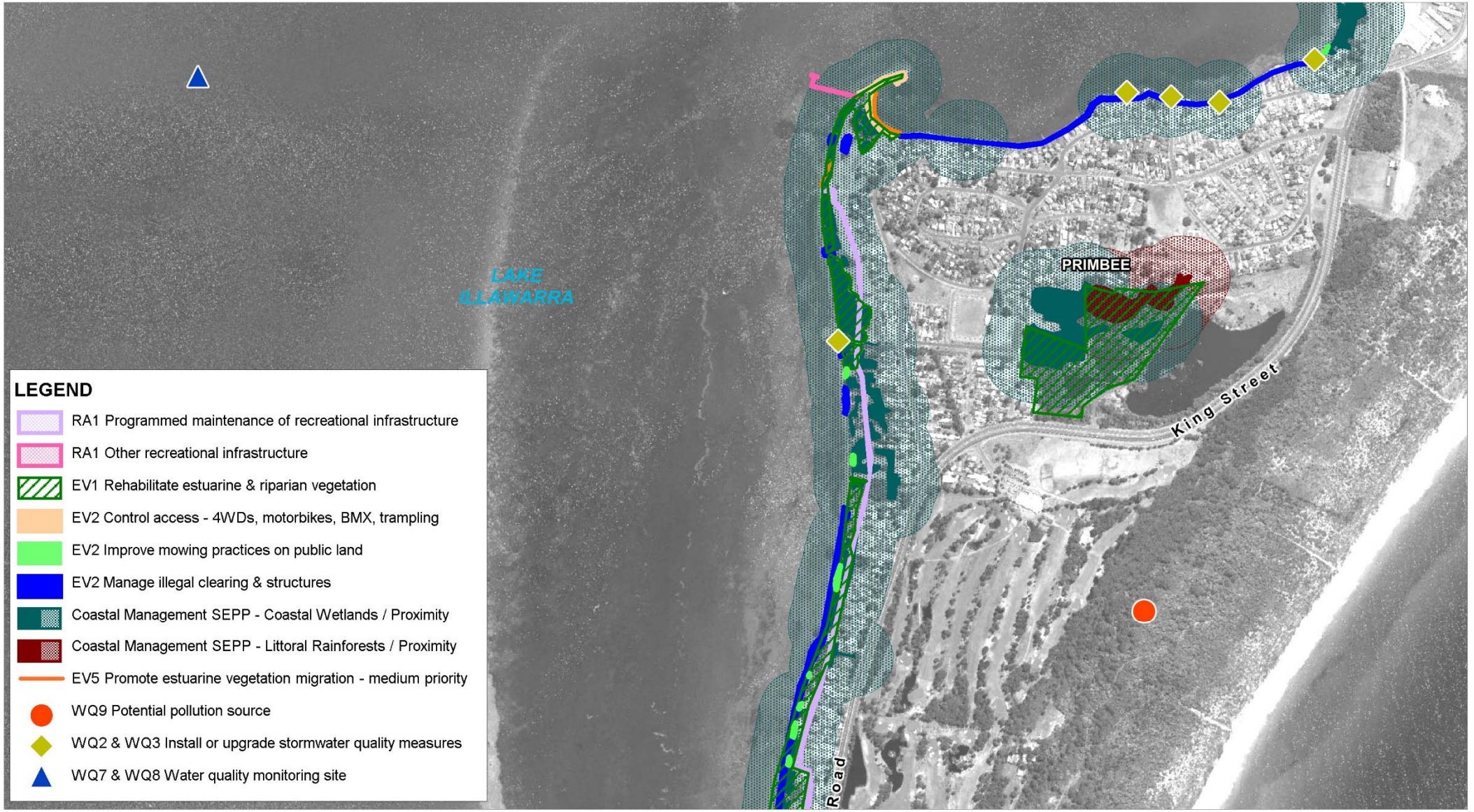

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Lake Illawarra Management Actions - Zone 9

Figure: **5-10**

Rev: **C**

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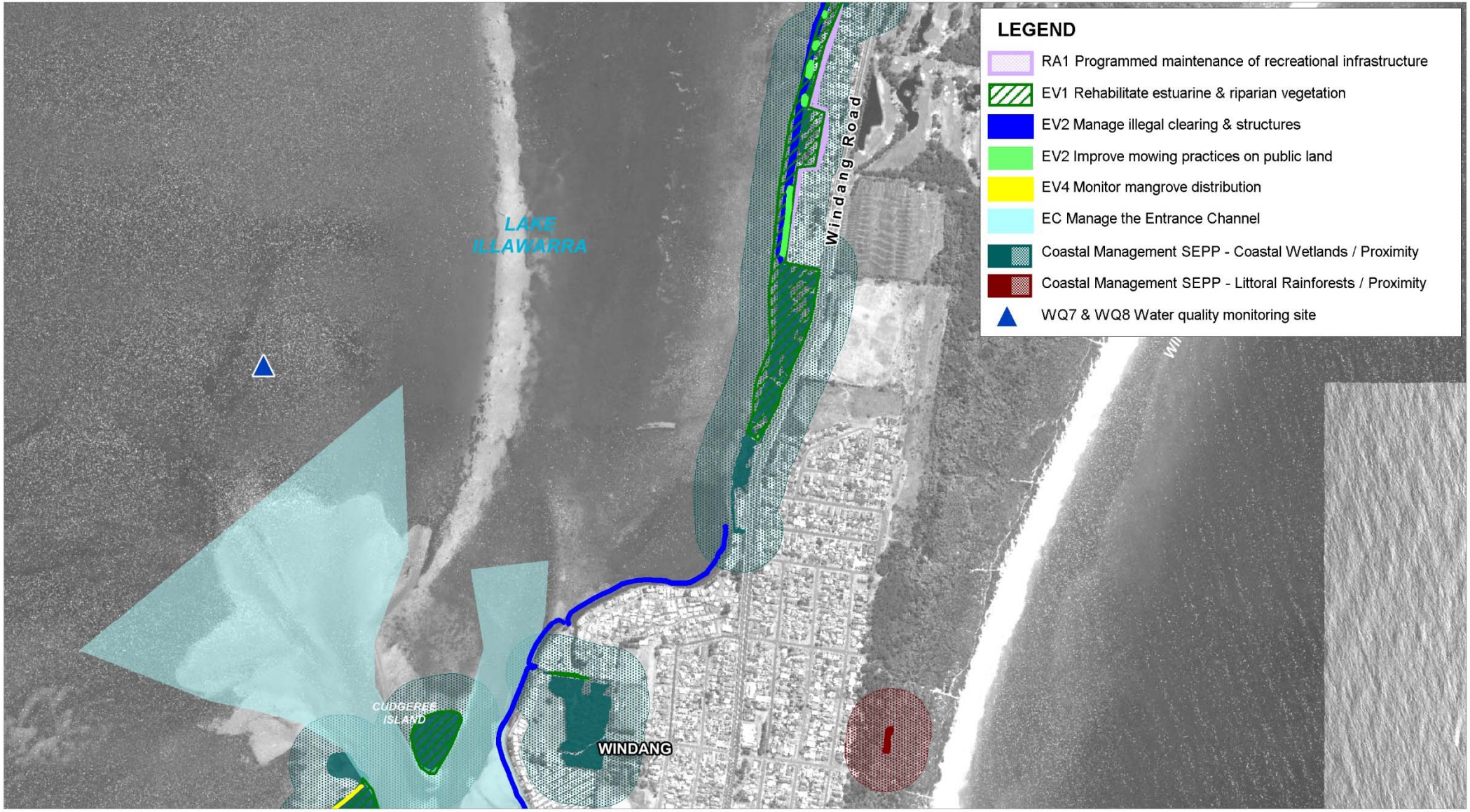
Filepath: K:\N20606_Lake Illawarra CZMP\GIS\GIS_2019\CMP\Workspaces\CMP_Zone9.wor



Title:

Lake Illawarra Management Actions - Zone 10

Figure: **5-11**

Rev: **C**

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

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6 Business Plan

6.1 Intent and Value of Implementing the Lake Illawarra CMP

Preserving and restoring the water quality and environmental habitats of Lake Illawarra is vital to the culture and economy of the local community, with benefits flowing on to the entire state of NSW. The Lake supports numerous important habitats including endangered ecological communities such as coastal saltmarsh, and these habitats in turn support a variety of species. In recognition of their high environmental values, NSW legislation requires such habitats to be protected and maintained.

The Lake Illawarra CMP is a program of physical works, monitoring and investigations, and planning and education initiatives that target the threats to the Lake's ecological and cultural values. The CMP also includes actions directly aimed at improving recreational opportunities for the public; and targets coastal hazards that are present in the Lake now and may occur in future.

Investment in the Lake Illawarra CMP provides an opportunity to directly improve and preserve the water quality, environmental habitats, cultural spaces and recreational opportunities of Lake Illawarra, and in doing so, bring benefits to the public. The Lake Illawarra CMP contains 39 actions set out within nine strategies, that aim to manage, preserve, improve, promote and rehabilitate our Lake. Many of the actions are targeted towards improving ecological health, as this is the key to supporting the recreational, cultural and economic values of the Lake. And while ecological actions are more numerous, financial resources are well targeted towards supporting recreational amenity, such as for upgrades to facilities and navigation. Funding will be required for many of the actions, and will be vital for the success of the CMP.

6.2 Resource and Financial Planning

Delivery of the Lake Illawarra CMP is estimated to cost $36,340,000 over 10 years. Existing staff resources in the Councils with the support of relevant agencies including DPIE - Coasts & Estuaries, are expected to facilitate the delivery of actions as per the Strategy Implementation Plan, with the Councils, state agencies and other stakeholders responsible for funding and/or implementing the actions. It should be acknowledged that as technology and new information changes other management actions may become feasible and will be reviewed for inclusion in the plan. Where additional staff resources have not been identified, this is expected to have an impact on current resourcing levels within both Councils, the financial requirements for this have been included in the Business Plan (e.g. see PM2 in Table 6-1). It is anticipated that both WCC and SCC will work together under a MoU with the guidance of a Stakeholder Reference Group. Each individual council will still be the ultimate decision maker but is expected to provide updates to the Stakeholder Reference Group.

Based upon the timeframes for actions and estimated costings, $6,933,000 is required in Year 1 to implement specified actions. A forecast $14,587,000 is estimated across Year 2 to 5 (inclusive), with a final $14,820,000 required over Years 6 to 10 for the program. The cost estimates and their breakdown across the specified years for delivery is provided in Table 6-1.

It should be noted that it is difficult to definitively forecast the costs to funding of the CMP beyond Year 1. Likewise, costings are not indexed. Councils prepare a yearly budget, and through this

process, actions from the CMP will be fed into these yearly budgets. For all responsible or supporting organisations that are identified, the actions remain subject to funding, availability of resources, and organisational and/or government priorities. For example, other Council and State Government priorities and budgetary processes in play that may affect the timing of or ability to implement for implementation of CMP actions. Further to this, there may be situations where CMP actions are delayed, for example funding will be required, and this will change the projections for yearly spend beyond Year 1. As such, costs are provided as a forecast for Year 2 onwards.

Due to many CMP actions involving works on the foreshore of the Lake and its tributaries, Aboriginal Cultural Heritage requirements may be invoked if ground disturbance is needed. Depending on the situation and the works being undertaken, these requirements can be reasonably time consuming and costly. It is therefore possible that particular CMP actions may face implementation delays if this occurs. These requirements are necessary to ensure Aboriginal Cultural Heritage is protected and preserved and as such timeframes may have to be revised as issues arise. This should be considered when updating any forward plans or this Business Plan.

Similarly, coastal hazards can present delays particularly when and impact occurs earlier than anticipated or is more severe than expected. Again, this may affect funding and financing in any one year.

As implementation of the CMP progresses, relevant sections of Councils' Business Plans will be updated on a yearly basis to reflect the budget for the CMP for each upcoming year, to allow relevant actions to be fed into the implementation process, and to account for external grant funding awarded to implement CMP actions (see Financing and Funding below). Councils must integrate these actions into their operational plan, where they can be formally adopted.

Action ID	Action	Estimated cost of actions (subject to available funding)	Timeframe (subject to available funding and resources)	Year 1 (estimate)	Year 2 to 5 (forecast estimate)	Year 6 -10 (forecast estimate)	Potential Funding Sources	Alignment with IP&R Frameworks
	Total cost for CMP	**$36,340,000**		**$6,933,000**	**$14,587,000**	**$14,820,000**		
Strategy 1: Improve Water Quality (WQ)								
WQ1	Implement a Risk Based Stormwater Management Framework for the Lake Illawarra catchment	Estimated total of $245,000 = $200,000 for DPIE research project (already funded), plus $25,000 for staff resources (= 1/4 of the $100,000 for temporary resource to be shared across WQ1 to 4), plus $20,000 for analysis and report preparation for RBF trial.	Year 1 to 3	$200,000	$45,000		• Council (Ordinary Rates, Revenue) • Developer Contributions • NSW Coastal and Estuary Grants Program	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6. SCSP 2023 • Objective 2.1: Strategy 2.1.1.
WQ2	Upgrade existing stormwater quality management measures, or install new devices, which may include water sensitive urban design or other design that will improve water quality as well as enhance habitat and natural values	Estimated total of $1.565 million = $25,000 for staff resources (= 1/4 of the $100,000 for temporary resource to be shared across WQ1 to 4), plus $60,000 for consultancy to complete stormwater audit, plus $1.4 million for new/upgrades to devices (estimated for years 4-10, exact number and costs for devices to be determined through audit), plus $80,000 for monitoring ($10,000 p.a. for 8 years).	Year 1 to 10	$30,000	$485,000	$1,050,000	• Council (Ordinary Rates, Revenue) • Council Special Rates • NSW Coastal and Estuary Grants Program	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6. SCSP 2023 • Objective 2.1: Strategy 2.1.1. • Objective 3.1: Strategy 3.1.2.
WQ3	Review and prioritise maintenance and cleaning regime for existing stormwater quality devices	Estimated total of $2.455 million = $25,000 for staff resources (= 1/4 of the $100,000 for temporary resource to be shared across WQ1 to 4), plus $30,000 for consultancy to conduct review and develop maintenance program plus $2.4 million in maintenance ($10,000 per device p.a. for approx. 30 devices over 8 years - WCC own 17 of the devices and SCC own 13 of the devices).	Year 1 to 10	$30,000	$925,000	$1,500,000	• Council (Ordinary Rates, Revenue) • Council Special Rates	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6. SCSP 2023 • Objective 2.1: Strategy 2.1.1.
WQ4	Design and implement targeted catchment input monitoring as required for developments resulting in a large-scale change or intensification of land use	Estimated total of $25,000 for staff resources (= 1/4 of the $100,000 for temporary resource to be shared across WQ1 to 4). Cost of monitoring program will be variable and developed on a case by case basis, with costs borne by the developer(s).	As required		$25,000		• Council (Ordinary Rates, Revenue) • Developer Contributions • NSW Coastal and Estuary Grants Program	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6. SCSP 2023 • Objective 2.1: Strategy 2.1.1.
WQ5	Reduce sediment load to the Lake by improving compliance with erosion & sediment controls for development sites	Estimated total of $1.6 million (based on staff resources of $160,000 p.a. for 10 years).	Ongoing	$160,000	$640,000	$800,000	• Council (Ordinary Rates, Revenue)	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6. SCSP 2023 • Objective 2.1: Strategy 2.1.1.
WQ6	Reduce the impact of sewer overflows	Staff time only.	Year 1 and ongoing				• Sydney Water • Council (Ordinary Rates, Revenue)	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6. SCSP 2023 • Objective 2.1: Strategy 2.1.1. • Objective 3.1: Strategy 3.1.2.
WQ7	Implement water quality monitoring programs for estuary health, recreational use and physico-chemical and bacteriological indicators in the Lake and its catchment	Estimated total of $1.3 million = $120,000 p.a. plus staff time of $10,000 p.a. for 10 years.	Year 1 to 5, then reviewed, continue Year 6 to 10.	$130,000	$520,000	$650,000	• NSW Coastal and Estuary Grants Program • Council (Ordinary Rates, Revenue) • Special Infrastructure Contribution	WCSP 2022 • Goal 1: Objective 1.2. SCSP 2023 • Objective 2.1: Strategy 2.1.1. • Objective 1.1: Strategy 1.2.1.
WQ8	Improve litter management	Estimated total of $530,000 = $11,000 p.a. for extra bins in summer ($5,500 for each LGA), plus $20,000 p.a. for 4 large scale clean up events (2 per LGA), plus $22,000 p.a. compliance project costs ($10,000 for SCC, $12,000 for WCC).	Year 1 to 10	$53,000	$212,000	$265,000	• Council (Ordinary Rates, Revenue) • Council Special Rates	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6. SCSP 2023 • Objective 2.1: Strategy 2.1.1.
WQ9	Investigate and manage potential pollution sources including contaminated sites that contribute to poor water quality in the lake	Estimated total of $240,000 = $60,000 p.a. plus staff time over 4 years.	Year 2 to 5		$240,000		• NSW Coastal and Estuary Grants Program • Council (Ordinary Rates, Revenue)	WCSP 2022 • Goal 1: Objective 1.2. SCSP 2023 • Objective 2.1: Strategy 2.1.1.

Action ID	Action	Estimated cost of actions (subject to available funding)	Timeframe (subject to available funding and resources)	Year 1 (estimate)	Year 2 to 5 (forecast estimate)	Year 6 -10 (forecast estimate)	Potential Funding Sources	Alignment with IP&R Frameworks
Strategy 2: Improve Planning and Management Arrangements for the Lake (PM)								
PM1	Commence integration of key objectives and strategies from the CMP into relevant planning and policy documents of both Councils	Estimated total of $100,000 plus staff time = assumed 2 episodes of consultancy assistance @ $50,000 each, plus staff time.	Year 2 to 10		$50,000	$50,000	• Council (Ordinary Rates, Revenue) • NSW Coastal and Estuary Grants Program	WCSP 2022 • Goal 1: Objective 1.1, Objective 1.6 SCSP 2023 • Objective 2.1: Strategy 2.1.1, Strategy 2.1.2. • Objective 2.3: Strategy 2.3.2.
PM2	Provide ongoing coordinated management of the Lake, which will require ongoing support for existing staff resources	Estimated total of $2.5 million = staff resources ($250,000 p.a. for 10 years).	Year 1 and ongoing	$250,000	$1,000,000	$1,250,000	• Council (Ordinary Rates, Revenue) • NSW Coastal and Estuary Grants Program	WCSP 2022 • Goal 1: Objective 1.1, Objective 1.6 SCSP 2023 • Objective 2.1: Strategy 2.1.3. • Objective 2.3: Strategy 2.3.6.
PM3	Develop and implement a community engagement and participation strategy that enhances the community's knowledge of, skills in, and commitment to, protecting Lake Illawarra	Estimated total of $980,000 = $80,000 p.a. for a staff member to develop and implement program plus $20,000 p.a. for resourcing program implementation.	Year 1 - staff time, then yearly for program	$80,000	$400,000	$500,000	• NSW Coastal and Estuary Grants Program • Council (Ordinary Rates, Revenue) • NSW Environment Trust • National Trust Programs	WCSP 2022 • Goal 1: Objective 1.1, Objective 1.6 • Goal 4: Objective 4.2 SCSP 2023 • Objective 2.1: Strategy 2.1.2, Strategy 2.1.4. • Objective 2.2: Strategy 2.2.1. • Objective 1.1: Strategy 1.1.7.
PM4	Establish a Lake Illawarra Asset Management Working Group that provides coordination services for agencies that manage assets around the Lake Illawarra foreshore	Estimated total of $70,000 = $5,000 p.a. for 10 years plus $20,000 for Development of a Framework document, plus staff time.	Year 1 and ongoing	$25,000	$20,000	$25,000	• NSW Coastal and Estuary Grants Program • Council (Ordinary Rates, Revenue) • NSW Environment Trust • National Trust Programs	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6 • Goal 5: Objective 5.3, Objective 5.5 SCSP 2023 • Objective 2.1: Strategy 2.1.3. • Objective 2.3: Strategy 2.3.6. • Objective 3.1: Strategy 3.1.2. • Objective 1.2: Strategy 1.2.3.
Strategy 3: Manage the Entrance Channel (EC)								
EC1	Investigate options to manage erosion and accretion changes in the entrance channel and implement management solutions	Estimated total of $1.96 million for investigations = $500,000 for management options study + $500,000 for detailed design, approvals etc for immediate response actions + $1 M for detailed design, CBA, approvals etc for long-term management option/s.	Year 1 to 10	$500,000	$1,500,000		• Council (Ordinary Rates, Revenue) • NSW Coastal and Estuary Grants Program • Special Infrastructure Contribution • Fisheries Habitat Action Grants	WCSP 2022 • Goal 1: Objective 1.2 SCSP 2023 • Objective 2.1: Strategy 2.1.3.
EC2	Undertake small scale works (e.g. beach scraping, re-shaping etc) to maintain swimming areas	Based on $50,000 - $150,000 per event, estimated total of $300,000 = assuming 3 episodes @ $100,000 per event for this costing spreadsheet.	As required		$100,000	$200,000	• NSW Coastal and Estuary Grants Program • Council (Ordinary Rates, Revenue) • NSW Environment Trust • Fisheries Habitat Action Grants	WCSP 2022 • Goal 5: Objective 5.3, Objective 5.5. SCSP 2023 • Objective 2.1: Strategy 2.1.3. • Objective 2.3: Strategy 2.3.6.
EC3	Undertake emergency works or small scale no-regrets actions as required to mitigate known risks to property and public safety	Estimated total of $3.15 million for: $150,000 for one dredging campaign + $0.5M to place rocks below Windang Bridge piers for stability + $0.5M to repair and make safe failing sections of protection works on northern foreshore east of bridge.	Year 1 to 5	$3,000,000	$650,000		• Council (Ordinary Rates, Revenue) • NSW Coastal and Estuary Grants Program • Special Infrastructure Contribution • Crown Lands Rescuing our Waterways Program (i.e. for dredging)	WCSP 2022 • Goal 5: Objective 5.3, Objective 5.5. SCSP 2023 • Objective 2.1: Strategy 2.1.3. • Objective 2.3: Strategy 2.3.6.
EC4	Monitor changes to the entrance channel	Estimated total of $20,000 = $10,000 initially then $5,000 every 2-5 years.	Year 1, then every 2-5 years	$10,000	$5,000	$5,000	• NSW Coastal and Estuary Grants Program • Council (Ordinary Rates, Revenue) • NSW Environment Trust • National Trust Programs	WCSP 2022 • Goal 1: Objective 1.2 SCSP 2023 • Objective 2.1: Strategy 2.1.3.
EC5	Monitor and maintain existing entrance channel infrastructure, with any works to be informed by EC1-EC2 and EC4	Estimated total of $2 million = assumed $200,000 p.a. for this costing spreadsheet, based on an estimated maintenance cost of $150,00-$240,000 p.a.	Ongoing	$200,000	$800,000	$1,000,000	• Marine Infrastructure maintenance programs (Crown Lands / RMS) • Council (Ordinary Rates, Revenue) • NSW Coastal and Estuary Grants Program	WCSP 2022 • Goal 1: Objective 1.2 • Goal 5: Objective 5.3 SCSP 2023 • Objective 2.1: Strategy 2.1.3. • Objective 2.3: Strategy 2.3.6.

Action ID	Action	Estimated cost of actions (subject to available funding).	Timeframe (subject to available funding and resources)	Year 1 (estimate)	Year 2 to 5 (forecast estimate)	Year 6 -10 (forecast estimate)	Potential Funding Sources	Alignment with IP&R Frameworks
Strategy 4: Protect and Rehabilitate Estuarine and Riparian Vegetation (EV)								
EV1	Rehabilitate vegetation and manage public access along foreshores and banks of the Lake, its tidal tributaries, islands and broader low-lying areas	Estimated total of $2.35 Million = $590,000 for SCC sites ($59,000 p.a. for 10 years), plus $570,000 ($190,000 p.a. for 3 years) already committed by WCC to the Natural Areas Restoration Program, plus $990,000 costed for known WCC sites, plus $200,000 for additional new sites (estimated 20 sites @ $10,000 each - WCC = 15 of the sites and SCC = 5 of the sites).	Year 1 and ongoing	$368,000	$1,092,000	$890,000	• NSW Coastal and Estuary Grants Program • NSW Environment Trust • Crown Reserves Improvement Fund • Building Resilience to Climate Change • NSW Heritage Grant Programs • Minor environmental grants through LLS and DPI Fisheries (e.g. Fish Habitat Grants)	WCSP 2022 • Goal 1: Objective 1.2 SCSP 2023 • Objective 2.1: Strategy 2.1.1, Strategy 2.1.2.
EV2	Undertake targeted action to control damage to foreshore vegetation, including seagrasses	Estimated total of $1.1 million = $300,000 for works (22 known sites plus 8 new (future) sites @ $10,000 each - WCC = 22 of the sites and SCC = 8 of the sites), plus $800,000 in additional staff resources ($80,000 p.a. for 10 years).	Year 1 and ongoing	$130,000	$470,000	$500,000	• NSW Coastal and Estuary Grants Program • NSW Environment Trust • Crown Reserves Improvement Fund • Building Resilience to Climate Change • NSW Heritage Grant Programs	WCSP 2022 • Goal 1: Objective 1.2 SCSP 2023 • Objective 2.1: Strategy 2.1.1, Strategy 2.1.2, Strategy 2.1.3.
EV3	Prepare and deliver an information program for the Lake Catchment	Estimated total of $120,000 = $20,000 to develop program, plus $100,000 for staff time and resources ($10,000 p.a. for 10 years).	Year 1 and ongoing	$30,000	$40,000	$50,000	• NSW Coastal and Estuary Grants Program • Council (Ordinary Rates, Revenue) • NSW Environment Trust • National Trust Programs	WCSP 2022 • Goal 1: Objective 1.6. • Goal 4: Objective 4.2. SCSP 2023 • Objective 2.2: Strategy 2.2.1.
EV4	Prepare and implement an estuarine macrophyte mapping and monitoring program	Estimated total of $160,000 = $150,000 (3 mapping events at $50,000 each) + $10,000 for area specific monitoring.	Year 1 (mapping), 2 to 4 (monitoring), 6 (mapping), 10 (mapping)	$50,000	$10,000	$100,000	• NSW Coastal and Estuary Grants Program • NSW Environment Trust • Building Resilience to Climate Change	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6. SCSP 2023 • Objective 2.1: Strategy 2.1.2, Strategy 2.1.4.
EV5	Develop and implement a program to enhance opportunities for estuarine vegetation migration	Estimated total of $275,000 =$25,000 for consultancy to develop program, plus $250,000 (estimated 5 sites at $50,000 each for migration actions - WCC = 3 of the sites and SCC = 2 of the sites).	Year 2 to 10		$175,000	$100,000	• NSW Coastal and Estuary Grants Program • Building Resilience to Climate Change • Coastal Lands Protection Scheme • NSW Environment Trust	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6. SCSP 2023 • Objective 2.1: Strategy 2.1.1, Strategy 2.1.2. • Objective 2.3: Strategy 2.3.6.
Strategy 5: Maintain and Improve Recreational Amenity (RA)								
RA1	Manage foreshore and waterway recreational infrastructure	Estimated total of $8.13 million = $1.87 million in upgrades already programmed in existing Council Infrastructure Delivery Programs ($220,000 in WCC and $1,650,000 in SCC for Years 1-3), plus independent audit of $60,000 (Year1-2), plus Lake Illawarra Waterway Facilities Plan of $50,000 + maintenance of $1.25 million (based on $5,000 per item for estimated 25 existing waterway assets p.a. over 10 years), plus estimated costing for new renewal items in future delivery programs of $4.9 million from Year 4 to 10 ($3.3 M in WCC and $1.6 M in SCC) (based on current Infrastructure Delivery Program of ~$2 M over 3 years).	Year 1 to 10	$1,277,000	$2,728,000	$4,125,000	• Council (Ordinary Rates, Revenue) • Crown Reserves Improvement Fund • State Infrastructure Contribution • Maritime Infrastructure Delivery Programs (RMS / Crown Lands)	WCSP 2022 • Goal 5: Objective 5.3, Objective 5.5. SCSP 2023 • Objective 3.1: Strategy 3.1.2. • Objective 1.2: Strategy 1.2.3.
RA2	Construct new sections of shared pathway to complete the pathway linkage around the Lake	Estimated total of $1.52 million = $520,000 for programmed works ($400,000) and feasibility study for and Around the Lake Share Path Plan ($120,000), plus $1,000,000 (estimated 5 sites @ $200,000 each - WCC = 3 of the sites and SCC = 2 of the sites) for new/upgraded sections.	Year 1 to 10	$200,000	$720,000	$600,000	• Council (Ordinary Rates, Revenue) • Crown Reserves Improvement Fund (and other DPIE - Crown Lands programs) • State Infrastructure Contribution	WCSP 2022 • Goal 5: Objective 5.5. • Goal 6: Objective 6.1 SCSP 2023 • Objective 1.2: Strategy 1.2.4.
RA3	Investigate the opportunities of public access along the foreshore and amend the acquisition layers of the relevant Council Local Environmental Plans if applicable	Staff time only.	Year 5 to 10				• Council (Ordinary Rates, Revenue) • Building Resilience to Climate Change • Coastal Lands Protection Scheme	WCSP 2022 • Goal 1: Objective 1.6 • Goal 4: Objective 4.2 SCSP 2023 • Objective 2.1: Strategy 2.1.3. • Objective 2.3: Strategy 2.3.2.
RA4	Build on the Tourism opportunities for Lake Illawarra	Staff time only.	Ongoing				• Council (Ordinary Rates, Revenue)	WCSP 2022 • Goal 4: Objective 4.2 SCSP 2023 • Objective 1.1: Strategy 1.1.1.
RA5	Conduct small scale dredging to improve public recreational outcomes and to improve the functionality of stormwater outlet infrastructure	Estimated cost is $700,000 = 4 dredging episodes at $175,000 each (based on estimated cost of $50,000 - $300,000 per episode) over the 10 year period. Note: if a dredging episode is costed at more than $300,000 (at 2020 prices) it should not be considered small scale for the purposes of this action, and should be investigated through action RA6.	Opportunistic and as needed over Year 1 to 10		$350,000	$350,000	• Council (Ordinary Rates, Revenue) • Crown Lands Rescuing our Waterways Program • NSW Coastal and Estuary Grants Program	WCSP 2022 • Goal 5: Objective 5.3 SCSP 2023 • Objective 1.2: Strategy 1.2.3.
RA6	Investigate the need for and viability of larger scale dredging of bays and the entrances to creeks or other measures to improve recreational amenity and access within the Lake where sedimentation and/or the changed nature of the entrance channel has negatively impacted on recreational use	Estimated cost of $300,000 for investigations. Note: if the investigations showed larger scale dredging was appropriate and viable the anticipated costs per episode would likely be $1M-$5M (which has not been included in this business plan).	By Year 6		$300,000		• Council (Ordinary Rates, Revenue) • Crown Lands Rescuing our Waterways Program • NSW Coastal and Estuary Grants Program	WCSP 2022 • Goal 5: Objective 5.3 SCSP 2023 • Objective 1.2: Strategy 1.2.3.

Action ID	Action	Estimated cost of actions (subject to available funding)	Timeframe (subject to available funding and resources)	Year 1 (estimate)	Year 2 to 5 (forecast estimate)	Year 6 -10 (forecast estimate)	Potential Funding Sources	Alignment with IP&R Frameworks
Strategy 6: Protect and Promote Cultural Heritage (CH)								
CH1	Protect and promote cultural heritage in and around the Lake and its catchment	Estimated total of $1.2 million = $1 million for staff resource ($100,000 p.a. for 10 years) and $200,000 for operating costs ($20,000 p.a. for 10 years).	Year 1 and ongoing	$120,000	$480,000	$600,000	• NSW Coastal and Estuary Grants Program • NSW Environment Trust • NSW Heritage Grant Programs • National Trust Programs	WCSP 2022 • Goal 1: Objective 1.4. SCSP 2023 • Objective 2.3: Strategy 2.3.5. • Objective 4.1: Strategy 4.1.3. • Objective 1.1: Strategy 1.1.1.
Strategy 7: Manage Foreshore and Bank Erosion (FB)								
FB1	Undertake a bank condition assessment and determine and implement erosion control measures	Estimated total of $300,000 = $60,000 consultancy for condition assessment and recommended controls (allocation of $5,000 to DPIE - Crown Lands and $55,000 to WCC/SCC), plus $40,000 for monitoring ($5,000 p.a. over 8 years), plus $200,000 for erosion controls works (estimated 5 sites at $40,000 each - WCC = 3 of the sites and SCC = 2 of the sites).	Year 1 (assessment), Year 2 to 4 (works), Year 3 to 10 (monitoring)	$60,000	$215,000	$25,000	• NSW Coastal and Estuary Grants Program • NSW Environment Trust • Crown Reserves Improvement Fund • Building Resilience to Climate Change • NSW Heritage Grant Programs	WCSP 2022 • Goal 1: Objective 1.2. SCSP 2023 • Objective 2.1: Strategy 2.1.2, Strategy 2.1.3.
FB2	Implement Environmentally Friendly Seawall Guidelines or similar for new and upgraded foreshore protection works	Estimated total of $150,000 (estimated 3 sites at $50,000 each - WCC = 2 of the sites and SCC = 1 of the sites).	Year 2 to 4		$150,000		• NSW Coastal and Estuary Grants Program • NSW Environment Trust • Crown Reserves Improvement Fund • Building Resilience to Climate Change	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6. SCSP 2023 • Objective 2.1: Strategy 2.1.2, Strategy 2.1.3. • Objective 3.1: Strategy 3.1.2.
FB3	Undertake a bathymetric survey of the entire Lake and tributaries up to the tidal limit	Estimated at $50,000.	Year 5		$50,000		• NSW Coastal and Estuary Grants Program • NSW Environment Trust • Building Resilience to Climate Change	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6. SCSP 2023 • Objective 2.1: Strategy 2.1.3, Strategy 2.1.4.
Strategy 8: Prepare for Inundation Risks (IR)								
IR1	Update Asset Management Plans for all publicly owned and managed assets to clearly identify asset at risk from inundation over future timeframes, including tidal inundation	Estimated total of $50,000 (estimated that of the 7 agencies, 5 will utilise minor consultancy assistance at $10,000 each) + staff time.	Year 2 to 4		$50,000		• NSW Coastal and Estuary Grants Program • Building Resilience to Climate Change • NSW Environment Trust	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6 SCSP 2023 • Objective 2.1: Strategy 2.1.3. • Objective 2.3: Strategy 2.3.6. • Objective 3.1: Strategy 3.1.2.
IR2	Prepare a whole of Lake Foreshore Adaptation Plan for public (community and environmental) lands	$80,000 plus staff time to incorporate findings into AMPs, POMs and masterplans as and when they are updated.	Year 5 to 7		$10,000	$70,000	• NSW Coastal and Estuary Grants Program • Building Resilience to Climate Change • NSW Environment Trust	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6 SCSP 2023 • Objective 2.1: Strategy 2.1.3. • Objective 2.3: Strategy 2.3.6. • Objective 3.1: Strategy 3.1.2.
IR3	Incorporate tidal inundation mapping into strategic land use planning documents	$20,000 plus staff time.	Year 2 to 4		$20,000		• NSW Coastal and Estuary Grants Program • Building Resilience to Climate Change • Coastal Lands Protection Scheme • NSW Environment Trust	WCSP 2022 • Goal 1: Objective 1.2, Objective 1.6 SCSP 2023 • Objective 2.1: Strategy 2.1.3. • Objective 2.3: Strategy 2.3.2.
IR4	Undertake water level and condition monitoring for all lake inundation events	Estimated total of $100,000 ($10,000 p.a. for 10 years).	Years 1 to 10	$10,000	$40,000	$50,000	• NSW Coastal and Estuary Grants Program • Building Resilience to Climate Change • NSW Environment Trust	WCSP 2022 • Goal 1: Objective 1.2 SCSP 2023 • Objective 2.1: Strategy 2.1.3. • Objective 2.3: Strategy 2.3.2.
IR5	Investigate novel solutions to manage inundation risks to assets such as stormwater, sewer, and water; cycleways, roads and bridges, etc	$30,000 plus research partnership (with a consultancy and/or university).	Years 5 to 10		$10,000	$20,000	• NSW Coastal and Estuary Grants Program • Building Resilience to Climate Change • NSW Environment Trust	WCSP 2022 • Goal 1: Objective 1.1; Objective 1.6 SCSP 2023 • Objective 2.3: Strategy 2.3.6. • Objective 3.1: Strategy 3.1.2. • Objective 2.1: Strategy 2.1.3.
Strategy 9: Protect and Manage Key Fauna (MF)								
MF1	Develop and implement a fauna management program including shorebirds, fish and other fauna	Estimated total of $125,000 = $15,000 to develop program, plus $60,000 for ecological surveys (3 at $20,000 each), plus $50,000 to implement program (e.g. for yearly shorebird habitat monitoring, data management etc).	Year 1 and ongoing	$20,000	$60,000	$45,000	• NSW Coastal and Estuary Grants Program • NSW Environment Trust • NSW Heritage Grant Programs • National Trust Programs • Building Resilience to Climate Change	WCSP 2022 • Goal 1: Objective 1.1. SCSP 2023 • Objective 2.1: Strategy 2.1.1, Strategy 2.1.2, Strategy 2.1.4.

6.3 Funding and Financing

WCC and SCC have budget allocations to assist with implementing actions to achieve the environmental goals and objectives of their respective Community Strategic Plans. As the Lake Illawarra CMP actions fall largely under these environmental goals and objectives (see details at the end of this Business Plan), the existing budgets of the Council may fund some or part of the actions, particularly in the CMP's first year until grant funding applications can be made. There is an existing arrangement between the councils that for lake wide actions or actions that span areas in both LGAs that costs are shared at a ratio of 2:1 for WCC to SCC.

There are a range of other funding mechanisms available for financing the implementation of the CMP. Councils have the opportunity to take advantage of the various local, state and federal grant programs, as listed in Table 6-2. The quantity of this funding cannot be accurately quantified until such time as it is awarded.

The staffing resources required to facilitate the implementation of the CMP across the two Councils and their various departments, to forward plan for commencing and progressing the actions over 10 years, and in particular to seek and obtain grant funding to achieve this, are set out for this CMP via Action PM2: Provide ongoing coordinated management of the Lake. It will be imperative that both Councils and the state agencies maintain good working relationships, as a basis for successful implementation of the CMP.

Through the use of existing Council budgets, seeking grant funding and donations wherever possible, and funding ongoing staff resources to plan, apply for grants, and then progress implementation of actions, it is hoped there will continue to be sufficient funds available to implement this CMP over its intended life of 5 to 10 years.

Beyond this timeframe, there will continue to be risks to the health and sustainability of the Lake, such as from climate change and development pressures, as well as new emerging risks. This CMP is expected to be revised after 10 years, and reviewed in five years, as detailed in Chapter 7.

Table 6-2 Local, NSW and Federal Government Funding Mechanisms

Funding Source	Details
Council Funding Mechanisms	
Council Ordinary Rates	A key funding mechanism for Council are statutory rates and charges, which can be applied to private landowners and businesses. Under the *Local Government Act 1993* (LG Act), ordinary rates can be applied to all rateable land within a local government area. This money can be used to fund delivery of community assets and services and may also be used to implement coastal management actions.
Special Rates	Specific works, services, facilities or activities that benefit certain parcels of rateable land can be funded (in whole or part) by Council by applying special rates under the LG Act. Where a coastal management action directly benefits a property owner, special rates provide a mechanism for Council to secure contributions from those landowners over time. Special rates can be implemented in different ways. Council can issue rates over a property or alternatively enter into an arrangement with the owner for payment of a lump-sum amount. Where a property, or properties, benefit from a coastal protection service, a coastal protection service charge can be applied (see below).
Coastal Protection Service Charge	The coastal protection service charge can be applied on rateable land where that land benefits from a coastal protection service, such as a seawall, erosion control measure or beach nourishment for example. The charge can be applied where coastal protection works are constructed by, or on behalf of the owner or occupier (current or previous). The charge can also be applied where coastal works are constructed in a joint arrangement between an owner or occupier and a public authority or council. The charge is applied to cover Council costs for construction, maintenance or repair of the works, as well as managing/remediating the impacts caused by the works. (refer to the NSW Coastal Management Manual (OEH, 2018) for further information).
Development Contributions	Developer contributions enabled under the *Environmental Planning and Assessment Act 1979* may be used for coastal management in some instances, such as funding capital works to manage the development impacts on the coast or reduce risk to the development from coastal hazards. WCC and SCC differ in the way that they collect and manage Developer Contributions. The criteria and ability to use those contributions will be dependent on the relevant Developer Contribution Plan.
Revenue Generated by Council	Council can also fund coastal management initiatives through revenue they may generate through hire, rental or other commercial partnerships (e.g. Surf Life Savings Clubs, Holiday Parks etc).
NSW Government Funding Mechanisms	
NSW Coastal and Estuary Grants Program	Under this program, the NSW Government provides grants to local government to support coastal management planning (e.g. hazards studies, management plans/programs) and actions to manage the risks of coastal hazards (e.g. erosion protection), restore degraded coastal habitats (e.g. wetlands, dunes) and improve the health of NSW estuaries. Funding of up to 50% of a project cost is available to successful applications and the programme is administered by DPIE - Coasts & Estuaries. Grant funding will be prioritised to Council applications associated with certified Plans. The program has funded 5 Wollongong City Council and 2 Shellharbour City Council projects worth a total of $834,000.00 since 2017/2018.

Funding Source	Details
Building Resilience to Climate Change	The partnership program between Local Government NSW (LGNSW) and DPIE aims to address climate change risks and vulnerabilities facing NSW councils. It aims encourage climate change: planning, minimisation, adaptation and implementation adaptation responses.
NSW Environment Trust	Funding is available under the NSW Environment Trust to a broad range of organisations for projects that enhance the environment of NSW. Grants may be awarded for on ground rehabilitation and improvement works, research applications, land acquisition, waste reduction and promotion of environmental education. Individual grants of up to $100,000 with a total of $2 million is available for government entities. The NSW Environment Trust is an independent statutory body established by the NSW Government to make and supervise the environment grants. The Trust is administered by DPIE. Suitable coastal management grant applications may relate to dune care, for example.
Crown Reserves Improvement Fund (CRIF)	The CRIF is administered by DPIE – Crown Lands providing financial support for the development, maintenance and improvement of public reserves. Subject to a competitive application process, the funds may be available to Council for eligible activities / works on coastal Crown reserves managed by Council. There is no set limit for a funding application. In previous rounds, the funding requests have ranged from $500 to $2 million.
NSW Heritage Grant Programs	This program is administered by DPIE and aims to fund projects that provide sustainable, long-term heritage benefits and provide public benefit and enjoyment from heritage. Funding may be available for the management of heritage items in the coastal environment. Aboriginal Cultural Heritage Grants: • Funding for activities and works identified in a finalised heritage management document or tool has a minimum of $20,000 and a maximum of $70,000. • Funding for cultural participation projects that engage the wider community to understand, celebrate and participate in Aboriginal cultural heritage has a minimum of $10,000 and maximum of $50,000. Community Heritage Grants: • Up to $60 000 depending on project type Small Heritage Grants: • up to $10,000
Special Infrastructure Contributions	Special Infrastructure Contributions (SIC) help fund the delivery of some of the key pieces of State and regional infrastructure required to support a growing population, such as: • state and regional roads; • transport facilities such as bus shelters and interchanges; • regional open space, pedestrian links and cycleways; and • social infrastructure such as schools, healthcare and emergency services. They may also contribute to the cost of planning and offsetting biodiversity impacts. SICs are imposed through a Ministerial Determination. DPIE – PA is responsible for the SIC system. There is an annual budget allocation of $3 million.

Funding Source	Details
Coastal Lands Protection Scheme	The Coastal Lands Protection Scheme is used to bring significant coastal lands into public ownership and provides for their long term management and care. DPIE administers the Scheme, which receives an annual budget allocation of $3 million for strategic acquisitions, such as for. • Public access: to promote public access to the coastal foreshore • Scenic quality: to maintain the scenic quality of the NSW coast • Ecological values: to protect ecological sites of regional, state and/or national significance.
Crown Lands Rescuing our Waterways Program	The program aims to help deliver better access to local waterways for recreational and commercial waterway boaters and other users. Dredging projects that may be subsidised under this program include: • Dredging strategies and/or their supporting studies (e.g. sediment hydrodynamics) • Navigation for a range of vessels (recreational, tourism and commercial) • Access to public waterway infrastructures such as boat ramps and wharves • Pre-dredge activities for projects which are eligible and likely to proceed to dredging. for vessel navigation. Coastal councils can apply and are required to make a financial contribution of at least 50% of project costs and be responsible for developing and managing their projects. Funding of up to $1.5 million is available for projects on an annual basis. The program is currently set to end by June 2021.
Federal Government Funding Mechanisms	
National Partnership Agreement on Natural Disaster Resilience	The Australian Government partners with State Governments to fund priority disaster resilience initiatives through the National Partnership Agreement on Natural Disaster Resilience. The aim of the program is to enhance Australia's resilience to natural disasters through mitigation works, measures and related activities. Funding is prioritised in terms of states natural disaster risk profile and priorities and focuses on building disaster resilient communities. The Commonwealth will provide a total financial contribution to the States of up to $52.2 million, with an estimate of $13.5 going to NSW. The Commonwealth's financial contribution will cover up to 50% of the estimated cost of delivering the activities specified in a State's agreed Implementation Plan.

6.3.1 Cost Benefit & Distribution (Public/Private)

The multi-criteria cost benefit analysis compared CMP actions with the indirect and direct impact upon identified threats, weighted towards the level of threat. Through this process, actions in the CMP primarily aim to benefit estuary health, with flow-on benefits to the public (through improved recreation etc); and some actions primarily aim to benefit the public, with flow-on benefits to estuary health. There are no actions within the CMP that aim to directly benefit private interests. Therefore, no public-private cost sharing arrangements are required.

6.3.2 Implementation Responsibility, Cost Sharing and Funding Contributors

The implementation details provided in the CMP in Chapter 4 highlight the relevant responsible and supporting organisations, including state agencies, who will likely provide financial, technical and /or staff resources towards implementing various actions in the strategy implementation plan. The responsible organisation is expected to lead implementation of an action and obtain financial and/or

staff resources. Supporting organisations may support the responsible organisation to implement the action through the provision of technical or project management support (that would usually be considered standard business for that organisation), subject to availability, and in rare cases may provide financial support. The CMP requires each state agency that is identified as a responsible or supporting organisation for an action to agree to this responsibility in writing.

WCC and SCC are responsible for facilitating through budgetary processes the implementation of the program, using both specific staff resources and using existing elements of the IP&R Framework of both councils to undertake, track and measure the success of actions in the CMP. The integration into the IP&R framework would be considered through the Asset Management Planning process within the Resourcing Strategy. The Community Strategic Plan provides a vehicle for each community to express its long-term aspirations and is the critical link when translating strategic objectives into actions. The Resourcing Strategy makes clear what elements of the Community Strategic Plan each stakeholder is responsible for, with other levels of government, business, non-government organisations, community groups and individuals also having a role in achieving the outcomes of the Community Strategic Plan. SCC and WCC will consider the identified actions within the Coastal Management Plan and how best to implement them and consider the priorities of the Community as identified in the CSP. Through this process, funding and resource contributions from the state agencies will be sought and managed at the appropriate time (see “resource and financial planning” and “funding and financing options” for details regarding when contributions will be required from lead and support organisations). All potential Government funding programs which give rise to council accessing funds from are subject to individual eligibility requirements and government priorities, competitive funding rounds and assessment, and availability of funds for each respective program. As such, it is noted that grant funding needs to be applied for is not guaranteed.

There is a common understanding between the councils that for lake wide actions or actions that span areas in both LGAs that costs are shared at a ratio of 2:1 for WCC to SCC.

The public is anticipated to become involved in implementing CMP actions via education strategies that provide activities for the community to attend, and that aim to change the behaviour of community members to benefit the Lake.

6.3.3 Contingent Liabilities

A contingent liability is a potential liability that may occur, depending on the outcome of an uncertain future event. A contingent liability is recorded in the accounting records if the contingency is probable and the amount of the liability can be reasonably estimated.

The hydraulic adjustment of the entrance channel is an area of potential liability. Ongoing erosion of the northern foreshore may require more substantial investment in protection works than has been estimated. Investigations for appropriate short and long term management measures for erosion / accretion in the entrance channel shall be undertaken through Action EC1, with immediate actions permissible through EC3. However, adjustment of the channel will and should be expected to continue to occur over the next 100 years or more. Changes will be exacerbated by ongoing sea level rise. There may continue to be investment required as new challenges arise in the entrance channel area.

Managing the ecological response to the opening of the entrance is covered under Action EV5 (Develop and implement a program to enhance opportunities for estuarine vegetation migration) in the CMP. However, there may be a liability for Council should the ecological responses be greater (or worse) than expected.

The impacts arising from storms (which result in present day coastal hazards) and sea level rise are also considered a liability. In particular, the opening of the entrance channel has left the channel foreshores far more exposed to swell wave action that may generate erosion hazards. Remedial works following storms may consume budget allocations otherwise earmarked for environmental actions in this plan, although Councils do have access to disaster relief funding. The timing of impacts from sea level rise is difficult to predict, and there is potential for impacts to occur earlier or have a greater consequence than anticipated, which would in turn require actions to be implemented or brought into the CMP planning process earlier than anticipated.

An identified threats risk assessment has been completed and is outlined previously in Section 2.4, Table 2-2. There is also the possibility of delays to implementation due to NSW planning changes. Annual review of this business plan in combination with review of CMP implementation (see Section 7.2), will allow regular review of new or existing contingent liabilities, with the annual budget updated as necessary.

6.4 Alignment with the Integrated Planning and Reporting Framework

The Lake Illawarra CMP contains 39 actions set out within 9 strategies, that aim to manage, preserve, improve, promote and rehabilitate our Lake. The actions directly link to the identified threats (see Table 3-1).The Lake Illawarra CMP strategies and actions align with the goals, objectives and strategies of the Shellharbour and Wollongong Community Strategic Plans (CSP), as set out previously in Table 6-1. It should be noted that both CSPs are currently undergoing an update, however the goals, objectives and strategies are not expected to substantially change. To assist with scheduling the implementation of actions, a Gantt chart for the actions (timeline and budget) has been included in Table 6-3.

Table 6-3 Detailed Lake Illawarra CMP Gantt Chart - Including Budget ($)

Action ID	Action	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
WQ1	Implement a risk-based decision-making framework for the Lake Illawarra catchment.	$200,000	$45,000									$245,000
WQ2	Upgrade existing stormwater quality management measures, or install new devices, which may include water sensitive urban design or other design that will improve water quality as well as enhance habitat and natural values.	$30,000	$485,000				$1,050,000					$1,565,000
WQ3	Review and prioritise maintenance and cleaning regime for existing stormwater quality devices.	$30,000	$925,000				$1,500,000					$2,455,000
WQ4	Design and implement targeted catchment input monitoring as required for developments resulting in a large-scale change or intensification of land use.	$25,000										$25,000
WQ5	Reduce sediment loads to tributaries of the Lake by improving compliance with erosion and sediment controls for development sites.	$160,000	$160,000	$160,000	$160,000	$160,000	$160,000	$160,000	$160,000	$160,000	$160,000	$1,600,000
WQ6	Reduce the impact of sewer overflows.	Staff time only										$0
WQ7	Implement existing water quality monitoring programs for estuary health, recreational use and physico-chemical and bacteriological indicators in the Lake and its catchment.	$130,000	$520,000				$650,000					$1,300,000
WQ8	Improve litter management.	$53,000	$212,000				$265,000					$530,000
WQ9	Investigate and manage potential pollution sources including contaminated sites that contribute to poor water quality in the lake.		$240,000									$240,000
PM1	Commence integration of key objectives and strategies from the CMP into relevant planning and policy documents of both Councils.		$50,000				$50,000					$100,000
PM2	Provide ongoing coordinated management of the Lake, which will require ongoing support for existing staff resources.	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$2,500,000
PM3	Develop and implement a community engagement and participation strategy that enhances the community's knowledge of, skills in and commitment to, protecting Lake Illawarra.	$80,000	$400,000				$500,000					$980,000
PM4	Establish a Lake Illawarra Asset Management Working Group that provides coordination services for agencies that manage assets around the Lake Illawarra foreshore.	$25,000	$20,000				$25,000					$70,000
EC1	Investigate options to manage erosion and accretion changes in the entrance channel and implement management solutions.	$500,000	$1,500,000									$2,000,000
EC2	Undertake small scale works (eg beach scraping, re-shaping etc) to maintain swimming areas.		$100,000				$200,000					$300,000
EC3	Undertake emergency works or small scale no-regrets actions as required to mitigate known risks to property and public safety.	$3,000,000	$650,000									$3,650,000
EC4	Monitor changes to the entrance channel.	$10,000				$5,000				$5,000		$20,000
EC5	Monitor and maintain existing entrance channel infrastructure, with any works to be informed by EC1-EC2 and EC4.	$200,000	$800,000				$1,000,000					$2,000,000
EV1	Rehabilitate vegetation and manage public access along foreshores and banks of the Lake, its tidal tributaries, islands and broader low-lying areas.	$368,000	$1,092,000				$890,000					$2,350,000
EV2	Undertake targeted action to control damage to foreshore and lake vegetation, including seagrasses	$130,000	$470,000				$500,000					$1,100,000
EV3	Prepare and deliver an information program for the Lake catchment.	$30,000	$40,000				$50,000					$120,000
EV4	Prepare and implement an estuarine macrophyte mapping and monitoring program.	$50,000	$10,000				$50,000				$50,000	$160,000
EV5	Develop and implement a program to enhance opportunities for estuarine vegetation migration.		$175,000				$100,000					$275,000
RA1	Manage foreshore and waterway recreational infrastructure.	$1,277,000	$2,728,000				$4,125,000					$8,130,000
RA2	Construct new sections of shared pathway to complete the pathway linkage around the Lake.	$200,000	$720,000				$600,000					$1,520,000
RA3	Negotiate a public "right of way" along the foreshore, as opportunities present themselves.						Staff time only					$0
RA4	Build on the Tourism opportunities for Lake Illawarra.	Staff time only										$0
RA5	Conduct small scale dredging to improve public recreational outcomes and to improve the functionality of stormwater outlet infrastructure.		$350,000				$350,000					$700,000
RA6	Investigate the need for and viability of larger scale dredging of bays and entrances to creeks or other measures to improve recreational amenity and access within the Lake where sedimentations and/or the changed nature of the entrance channel has negatively impacted on recreational use.		$300,000									$300,000
CH1	Protect and promote cultural heritage in and around the lake and its catchment.	$120,000	$480,000				$600,000					$1,200,000
FB1	Undertake a bank condition assessment and determine and implement erosion control measures.	$60,000	$215,000				$25,000					$300,000
FB2	Improve the environmental performance and outcomes for foreshore protection works when the renewal of existing or construction of new infrastructure is required, where appropriate and feasible to do so.		$150,000									$150,000
FB3	Undertake bathymetric survey of the entire Lake and tributaries up to the tidal limit.					$50,000						$50,000
IR1	Update Asset Management Plans for all publicly owned and managed assets to clearly identify asset at risk from inundation over future timeframes, including tidal inundation.		$50,000									$50,000
IR2	Whole of Lake Foreshore Adaptation Plan for public (community and environmental) lands.					$10,000	$70,000					$80,000
IR3	Incorporate tidal inundation mapping into strategic land use planning documents.		$20,000									$20,000
IR4	Water level and condition monitoring for all lake inundation events	$10,000	$40,000				$50,000					$100,000
IR5	Investigate novel solutions to manage inundation risks to assets such as stormwater, sewer, and water; cycleways, roads and bridges, etc					$10,000	$20,000					$30,000
MF1	Develop and implement a fauna management program including shorebirds, fish, and other fauna.	$20,000	$60,000				$45,000					$125,000

7 Monitoring, Evaluation and Reporting Program

The Lake Illawarra CMP requires evaluation and reporting regarding the success of its implementation, and the success of actions in reducing the threats and maintaining the values of Lake Illawarra. Where implementation performance is sub-optimal, the evaluation process should identify contingencies to remedy the situation.

This CMP is to be the first of many iterations of a coastal program of works to manage Lake Illawarra, although it is not the first management document for the Lake. Such plans, and the studies that underpin them, should be revised at least every 10 years.

7.1 Internal Communication and Implementation

The importance of internal communications within and between the Councils cannot be over emphasised in the success or otherwise of implementation of this CMP. To support the integration of this CMP with the day to day operations of both councils, it is recommended that 12 months after the CMP is certified, and henceforth at yearly intervals, key staff from both Councils that are responsible for its implementation, in partnership with the regional DPIE - Coasts & Estuaries representative(s), undertake an internal workshop to gauge the status of implementation of the CMP and general understanding of its objectives through both Councils. The workshop would include a refresher of the CMP contents, to reinvigorate existing staff and for new staff.

7.2 Reporting on CMP Implementation

Both WCC and SCC deliver an Annual Report to document their progress in implementing the respective Councils' Delivery Program and Operational Plan activities over each financial year. Performance measures are included for each action in the Operational Plan.

In the Strategy Implementation Plan of this CMP (Chapter 4), each action has been given a performance measure. This can be used to feed actions into both Councils' Delivery Programs and Operational Plans or longer term Resourcing Plans.

The performance measures shall also be used to gauge whether the actions have been implemented or not, which can then be reported in the Annual Report. This provides for a yearly evaluation of the implementation status of each action in the CMP.

Where actions have not been included in the IP&R Framework, a yearly evaluation of those CMP actions by the officer(s) responsible for facilitating implementation of the CMP is recommended. This may be undertaken through the annual review of the Business Plan (see Section 7.2.1), or as a separate process.

If it is determined that an action is not being implemented in accordance with the nominated timeframe, then one or both of the following contingencies should be adopted:

- Determine the cause for the delay in implementation. If delays are funding based, then seek alternative sources of funding, including applying for new or novel grant funding programs. If delays are resource-based, seek additional assistance from stakeholder agencies and / or consider using an external consultancy to coordinate implementation of the action(s). This can be facilitated through the Business Plan; and if necessary,

- Modify and update the CMP to reflect a timeframe or costing for implementation of the action that is more achievable. It should be noted that revisions to the CMP would need to be endorsed by all relevant stakeholders and agencies responsible for implementation.

7.2.1 Annual Business Planning

The CMP Business Plan (Chapter 6) should be updated on an annual basis. The Business Plan reflects the expected cost of the CMP over the coming financial year and details the resourcing and financing arrangements to meet these costs. The Business Plan demonstrates the contribution from successful grant funding applications to specific actions, and the additional contribution required from the Councils.

The Business Plan reflects what actions: have been implemented, will be brought online for implementation in the coming financial year, are ongoing and require continued funding, have been carried over to the next financial year, and / or have been modified to improve the potential for implementation. The business plan provides an avenue for bringing delayed actions into play (for example, as identified through the reporting process, Section 7.2). Through the Business Plan, the financial, resourcing or timing requirements for delayed actions can modified, and forecasts adjusted to account for implementation of these actions over the coming or a future financial year.

The business plan will be a key document for tracking success in grant funding applications and part or full contributions from the Councils. It is this financial success that will guarantee the implementation of the CMP.

7.3 CMP Review

A review should be conducted after five years to measure the performance of the CMP in terms of actually managing and reducing the threats to the ecological, social and economic values of the Lake. That is, 'how has the CMP made a difference?' and 'has the level of risk or risk rating for the threats been reduced?'.

The main mechanism for gauging whether the CMP has been successful is to re-evaluate the threats through a repeat of the threat assessment process. As for the first threat assessment, all of the existing controls that assist with managing the threats should be included when assessing the level of risk, particularly those actions that have or are being implemented through the CMP. There are two specific questions to be answered:

- Has the level of risk changed? (including for those threats in this plan that are currently assessed as low); and
- Have the very high or high threats been adequately managed / mitigated? (i.e. has the risk rating been reduced to a tolerable level through management?).

If it is determined that the threats have not been adequately managed / mitigated, or that new intolerable threats have arisen, the following contingencies should be adopted:

- Carry out a formal review of the implemented management strategies, identifying possible avenues for increasing the effectiveness of the strategy in managing the risks along the coastline (including new risks);

- Commence implementation of additional/back-up management strategies that may assist in meeting the objectives of the CMP (possibly 'fast-tracking' some longer term strategies as necessary);
- Reconsider the urgency of management for key threats. Upscaling from passive to active management may be needed, for example, where climate change or entrance channel related threats have increased in severity and now require intervention to ameliorate impacts.

If the need arises, new actions or items can also be added to the CMP as part of the review process.

Any such changes to the CMP would need to be endorsed by the stakeholders and relevant government agencies, as well as the community.

7.4 Water Quality and Estuary Health Monitoring Program

7.4.1 Preamble

A CMP requires a monitoring, evaluation and reporting framework to be established to help determine whether the outcomes intended from the CMP implementation are being realised. One of the outcomes for the Lake Illawarra CMP is protection and improvement in water quality and estuary health of the Lake. The monitoring regime being recommended for this is outlined below.

7.4.2 Background

Water quality monitoring has been ongoing continuously since 2005, but has been added to and refined in more recent years to focus on estuary health. Additionally, recreational monitoring was expanded to cover 4 sites in the lake in late 2018.

It is noted, however, that a focus is on assessing estuary ecosystem health based on water quality indicators alone is somewhat limited. There is opportunity in an ongoing program to include other indicators that are also important for estuary health (such as macrophyte distributions), and to assess water quality for recreational use, given the lake is commonly used for recreational purposes by the community, and the potential for greater use of the lake for this purpose in the future.

Inputs from the catchment have a significant influence on the condition of the lake, and many of the management actions in the CMP relate to reducing these inputs over time. Therefore, targeted monitoring of catchment inputs is also recommended to assess how pollution loads being delivered to the lake are changing over time.

7.4.3 Objectives of the Monitoring Program

The objectives of the water quality and estuary health monitoring program are:

(1) Track the water quality and estuary health condition of the Lake for protection of aquatic ecosystems and for recreational use.

(2) Track the effectiveness of the CMP in reducing catchment inputs to the Lake, by undertaking targeting monitoring of pollution loads.

(3) Identify any emerging water quality and estuary health issues to inform the ongoing management strategy for the Lake.

(4) Keep the community updated on the water quality and estuary health condition of the Lake.

7.4.4 Lake Monitoring at Present

Under the current program being coordinated by WCC, the Lake is monitored at six foreshore and five in-lake locations. An analysis of the results collected over several years has shown that a number of these sites have very similar water quality (WCC, 2015, 2016, 2017, 2018a). Therefore, the number of sites recommended for ongoing monitoring can be rationalised, ensuring that sites with the longest data records are generally retained.

7.4.5 Catchment Monitoring at Present

SCC currently undertakes quarterly water quality sampling at sites throughout the LGA including the Lake Illawarra catchment. Results are reported through the Community Strategic Plan. This monitoring program is currently being reviewed. Physicochemical, nutrient and bacteriological data is gathered and is used inform management actions and identify areas of non-compliance where further investigation is required.

7.4.6 Monitoring Program for this CMP

Table 7-1 describes the overall monitoring design for the Lake, including the requirements for macrophyte monitoring. Action WQ7 outlines the costs, timeframes and responsibilities for undertaking the water quality monitoring program as it is proposed in Table 7-1. Action EV4 provides the details, costs, timeframes and responsibilities for undertaking the macrophyte mapping and monitoring, as proposed in Table 7-1 also.

The sites recommended for ongoing monitoring are shown in Figure 7-1. Table 7-2 presents further information on the location of the water quality sites. No attempt has been made to relabel the sites to ensure they can be related with earlier records. Three new sites have been added for recreational use monitoring. These are areas around the Lake that are already commonly used for a number of recreational activities. This is in addition to the site at Entrance Lagoon Beach that is currently monitored under the Beachwatch program. Water quality data that is collected by other agencies will be sourced where relevant and when it is considered useful to the objectives outlined above.

Table 7-1 Monitoring Design for Lake Illawarra

Lake use / value	Indicator	Sites	Frequency	Notes
Protection of aquatic ecosystems	Water quality: physico-chemical indicators (temperature, salinity, pH, dissolved oxygen, turbidity; total, dissolved and reactive forms of nitrogen and phosphorus), and chlorophyll *a*	Foreshore sites – 1,2,3, 4, 5, 6 Lake sites – NS1, NS2, NS3, EW1, EW2	Monthly	Protocols being used in the council program follow standard procedures consistent with the MER protocols, and these procedures can be retained.
	Macrophytes – seagrass, saltmarsh, mangroves	Entire lake	Within 2 years, then every 5 years	Follow guidelines in State of NSW and OEH (2016)
Recreational use	Enterococci	BW1, BW2, BW3, ELL	As per the NSW Beachwatch sampling regime	Follow Beachwatch protocol

Table 7-2 Location of Water Quality Monitoring Sites in Lake Illawarra

ID	Site Location	Lake Zone	Purpose
Site 2	Boat ramp at Windang Peninsula	Lake Entrance	For water quality and estuary health
Site 3	At Picnic Island	Lake Entrance	
Site 3A	Jetty at Boonerah Point Reserve	Lake Edge	
Site 4	Jetty at Sailing Club at Burroo Bay	Lake Edge	
Site 5	Boat ramp and jetty at Kanahooka	Lake Edge	
Site 6	Jetty at Griffins Bay Wharf	Lake Edge	
NS1	North along a north-south transect	In-lake	
NS2	Middle along a north-south transect	In-lake	
NS3	South along a north-south transect	In-lake	
EW1	East along an east-west transect	In-lake	
EW2	West along an east-west transect	In-lake	
BW1	At Ski Way Park	Lake Edge	For recreational use
BW2	At Kanahooka Boat Ramp	Lake Edge	
BW3	At Purry Burry Point, Primbee	Lake Edge	
ELL	At Entrance Lagoon Beach	Lake Entrance	

Figure 7-1 Location of Sampling Sites for the Water Quality and Estuary Health Monitoring Program and for Recreational Use

7.4.7 Information Relevant to Estuarine Macrophyte Monitoring

Lake Illawarra tidal inundation map highlighting the largest low-lying areas that could potentially allow for estuarine vegetation migration (outlined in red, refer Appendix E, Figure 11 of the BMT (2020a) *Lake Illawarra Information Synthesis Report*) and as sea level rises (see Figure 7-2) could be investigated further for this purpose. These low-lying areas are currently either agricultural lands or public foreshore land that is open parkland or vegetated. Other low-lying inundated areas not highlighted are generally already developed with housing or other significant infrastructure where it is less likely they could be managed to allow for estuarine vegetation migration. Other narrower strips of foreshore along the lake where some estuarine vegetation migration is possible also occur, where changes in management such as reducing the width of areas mowed will contribute to longer term conservation. These areas are marked on the more specific management action mapping.

LEGEND

- Identified potential areas for estuarine vegetation migration (Wiecek, 2018)
- 2016 HHWSS
- 2100 HHWSS

Title:

Lake Illawarra Estuarine Vegetation Migration Investigation Areas

Figure: **7-2**

Rev: **A**

N

0 1.25 2.5km

Approx. Scale

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Appendix A NSW Coastal Management Framework and Mandatory Requirements

A.1 Definition and Objectives for the Coastal Management Areas

A.1.1 Coastal Wetlands and Littoral Rainforest Area

Coastal wetlands and littoral rainforest support high value biodiversity that are particularly sensitive to development. This management area is defined in the CM Act as land which displays '*the hydrological and floristic characteristics of coastal wetlands or littoral rainforests and land adjoining those features*' (DPE, 2016). This area focusses on protecting well established and more extensive vegetation communities (as opposed to single trees or isolated stands). Specific controls on development apply to this management area, as set out in the Coastal Management SEPP.

The **objectives of the coastal wetland and littoral rainforest management area** within the *CM Act* are to:

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

Mapping at Lake Illawarra identifies coastal wetlands to extend across the low lying margins of the Lake, namely around Mullet Creek, Duck Creek and Macquarie Rivulet flood tide deltas, but also within and around the entrance channel and the Windang Peninsula region (see Figure 1-3). Littoral Rainforest areas are present on Windang Peninsula.

A.1.2 Coastal Vulnerability Area

Coastal fringing land threatened by coastal hazards will be encompassed within the coastal vulnerability management area. This area focusses on identifying land subject to current and future coastal hazards, and applying specific controls to inform land use decisions. Development in this management area is permitted, but must comply with the Coastal Management SEPP requirements (DPE, 2016).

The summarised **objectives of the coastal vulnerability management area** within the *CM Act* are to:

- ensure public safety and prevent risks to human life;
- mitigate current and future coastal hazards;
- maintain the presence of beaches, dunes and other natural features;

- maintain public access, amenity and use of the coast;
- encourage land use that reduces exposure to hazards, including through siting, design, construction and operational decisions;
- adopt coastal management strategies that reduce exposure to hazards, in the first instance by restoring or enhancing natural defences such as dunes, and thereafter by taking other action and;
- if taking other action, to;
    - avoid significant degradation or disruption of biological diversity, ecosystem integrity, coastal processes (ecological, biophysical, geological, geomorphological), beach and foreshore amenity, and social and cultural values;
    - avoid adverse offsite impacts, or otherwise restore the land if any impacts are caused by the action to reduce exposure to hazards;
- maintain essential infrastructure, and;
- improve community resilience and reduce reliance on emergency responses.

Hazard types specific to Lake Illawarra include entrance instability, coastal and tidal inundation, and foreshore erosion. The coastal vulnerability management area is not currently mapped in the CM SEPP. DPIE intends to identify areas to be included in the coastal vulnerability area over time (DPE, 2016).

Even though the SEPP mapping does not identify a vulnerability area in the Lake Illawarra coastal zone at present, these hazards do exist. The coastal inundation hazard area derived by Cardno (2010, 2012) may be used to represent the coastal vulnerability area for Lake Illawarra. The coastal inundation hazard area was modelled by Cardno (2010, 2012), using the levels shown in Table A-1, which represents inundation levels inside Lake Illawarra due to present day ocean water level events, and such events at 2050 and 2100 factoring in SLR. The 100 year Average Recurrence Interval (ARI) ocean water level for the present day of 1.44 m AHD was derived from guidance by DPIE - Coasts & Estuaries (formerly DECCW) for Fort Denison in Sydney. For the future time periods of 2050 and 2100, Cardno (2010, 2012) adopted a projected sea level rise of 0.4 m and 0.9 m respectively.

Wave set up was not included in the ocean water level boundary conditions, as swell waves do not penetrate into the estuary further than Windang Bridge, and as such, do not shoal and break to generate wave set up.

Cardno (2010) found that the peak ocean still water levels are modified in the estuary due to tidal attenuation through the Lake entrance. For example, the peak 100-years ARI storm ocean water level of 1.44 m AHD translated into an estuarine water level of 0.7 m AHD upstream of Windang Bridge.

Table A-1 Ocean Water Level Boundary Conditions for Coastal Inundation Modelling

Ocean Water Level Scenario	Indicative Timeframe	Water Level (m AHD)
Immediate: 100 yr. ARI ocean water level	Present Day	1.44
High risk: 100 yr. ARI ocean water level + 0.4 m SLR	2050	1.84
Low risk: 100 yr. ARI ocean water level + 0.9 m SLR	2100	2.34

A.1.3 Coastal Environmental Area

The NSW coastal environment is diverse and encompasses a range of different landforms, processes and environments. The coastal environment management area is land containing features such as the coastal waters of the State, estuaries, coastal lakes and lagoons, and land adjoining those features such as headlands and rock platforms.

The **objectives of the coastal environmental area** within the *CM Act* are to:

- protect and enhance coastal environmental values and natural processes of coastal waters, estuaries, coastal lakes, coastal lagoons, and enhance natural character, scenic value, biological diversity and ecosystem integrity;
- reduce threats to and improve resilience of these coastal environments, including in response to climate change;
- maintain and improve water quality and estuary health;
- support social and cultural values of the coastal environments;
- maintain the presence of beaches, dunes and natural features of the foreshore; and
- maintain and improve public access, amenity and use of the coast.

The Coastal Management SEPP acknowledges the important environmental values of the coastal environment management area and outlines a range of specific controls that aim to minimise the impact of development on this area (DPE, 2016). Draft mapping of the coastal environment area at Lake Illawarra encompasses the estuary waterbody and its entrance channel, plus a 500m fringe landward of the Lake and entrance foreshore, in addition to 1km upstream beyond the Highest Astronomical Tide within its tidal tributaries (see Figure 1-3).

A.1.4 Coastal Use Area

The coastal zone comprises land that is extremely valuable in terms of the economy and society. Indeed, the coastal zone supports a range of human uses and development types that enable the wider coastal community to live, work and play on the coast. The coastal use management area encompasses land adjacent to coastal waterways (ocean, estuaries, lakes etc.) where impacts of

development on the use and enjoyment of the beaches, dunes, estuaries and lakes need to be considered.

The **objectives of the coastal use management area** within the *CM Act* are 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 of development on cultural and built environmental 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;
- accommodate both urbanised and natural stretches of coastline.

The Coastal Management SEPP sets out controls specific for the coastal use management area that ensure development proposals address a range of public interest criteria.

A.2 Meeting the Mandatory Requirements and Essential Elements

Table A-2 Mandatory Requirements for a Coastal Management Program Relevant to Preparation of the Lake Illawarra CMP

Section 14 of the Coastal Management Act 2016 defines the preparation of CMPs as follows	How this CMP addresses these requirements
(1) A local council is to prepare a coastal management program in accordance with the coastal management manual.	The Lake Illawarra CMP has been prepared in accordance with the NSW Coastal Management Manual (OEH, 2018) that was current at the time of this CMP's preparation.
(2) The Minister may, by notice in writing given to a local council, direct the local council in its preparation of a coastal management program. A direction under this subsection prevails to the extent of any inconsistency between it and the coastal management manual.	The Minister has not directed the local councils in preparation of this CMP.
(3) In preparing a coastal management program, a local council must:	
(a) consider and promote the objects of this Act, and	The objects of the CM Act are reflected in the objectives of this CMP, see Section 1.5.
(b) give effect to the management objectives for the coastal management areas covered by the program, and	The management objectives for the coastal management areas are re-iterated in the coastal strategy statement and objectives of this CMP, see Section 1.5.

Section 14 of the Coastal Management Act 2016 defines the preparation of CMPs as follows	How this CMP addresses these requirements
(c) consider the State and regional policies and plans prescribed by the regulations for the purposes of this section.	Legislation relating to the management of the Lake is considered in Section 1.4.
(4) A direction under this section may specify the time within which the direction must be complied with.	This subsection does not apply as the Minister has not directed the local councils in preparation of this CMP.

Section 15 of the Coastal Management Act 2016 defines the matters to be dealt with in a CMP as follows	How this CMP addresses these requirements
(1) A coastal management program must:	
(a) identify the coastal management issues affecting the areas to which the program is to apply, and	A summary of the threats affecting Lake Illawarra is provided in Section 2.4, with detailed analysis of the threats outlined in the *Community Uses, Values, Threats and Opportunities Lake Illawarra Report* (BMT, 2020b).
(b) identify the actions required to address those coastal management issues in an integrated and strategic manner, and	A detailed multicriteria cost benefit analysis of the options was conducted, including assessment of the options direct influence on the threats to the Lake, in order to identify suitable actions for the CMP. This assessment is detailed in Section 3.3 and the *Lake Illawarra CMP Management Actions Assessment* (BMT, 2020c).
(c) identify how and when those actions are to be implemented, including those to be implemented by local councils under Chapter 13 of the *Local Government Act 1993*, those to be implemented under environmental planning instruments and development control plans under the *Environmental Planning and Assessment Act 1979* and those to be implemented by public authorities (other than the local council), and	The Strategy Implementation Plan in Chapter 4 provides details of how and when actions are to be implemented, and responsibilities for implementation (lead and support), including the local councils (WCC and SCC) and other public authorities. The implementation tables also indicate those actions to be implemented through changes to the LEP, DCP or other planning documents. The implementation tables also provide details to enable the actions to be implemented through both councils IP&R Frameworks.
(d) identify the costs of those actions and proposed cost-sharing arrangements and other viable funding mechanisms for those actions to ensure the delivery of those actions is consistent with the timing for their implementation under the coastal management program, and	The Strategy Implementation Plan in Chapter 4 provides details of estimated costs for the actions. The Business Plan in Chapter 6 (and Table 6-1 in particular) details further the financing and funding mechanisms for implementing the actions in the CMP.

Section 15 of the Coastal Management Act 2016 defines the matters to be dealt with in a CMP as follows	How this CMP addresses these requirements
(e) if the local council's local government area contains land within the coastal vulnerability area and beach erosion, coastal inundation or cliff instability is occurring on that land, include a coastal zone emergency action subplan.	Present day storm inundation risks are currently effectively managed through the Flood Risk Emergency Management process. This CMP sets out the process for defining the coastal vulnerability area for Lake Illawarra, refer to Section 1.3.1.1.
(2) A coastal management program may also include other matters as may be authorised or permitted by the coastal management manual.	This Lake Illawarra CMP focuses on improving or maintaining the environmental values of the Lake.
(3) A ***coastal zone emergency action subplan*** is a plan that outlines the roles and responsibilities of all public authorities (including the local council) in response to emergencies immediately preceding or during periods of beach erosion, coastal inundation or cliff instability, where the beach erosion, coastal inundation or cliff instability occurs through storm activity or an extreme or irregular event. For the purposes of this subsection, those roles and responsibilities include the carrying out of works for the protection of property affected or likely to be affected by beach erosion, coastal inundation or cliff instability.	A coastal zone emergency action subplan is not required for this Lake Illawarra CMP.
(4) A coastal management program must not include the following:	
(a) matters dealt with in any plan made under the *State Emergency and Rescue Management Act 1989* in relation to the response to emergencies,	This program does not deal with such matters.
(b) proposed actions or activities to be carried out by any public authority or relating to any land or other assets owned or managed by a public authority, unless the public authority has agreed to the inclusion of those proposed actions or activities in the program.	WCC and SCC have primary responsibility for all actions except WQ6 which is a shared responsibility with Sydney Water, with other agencies listed as support organisations.

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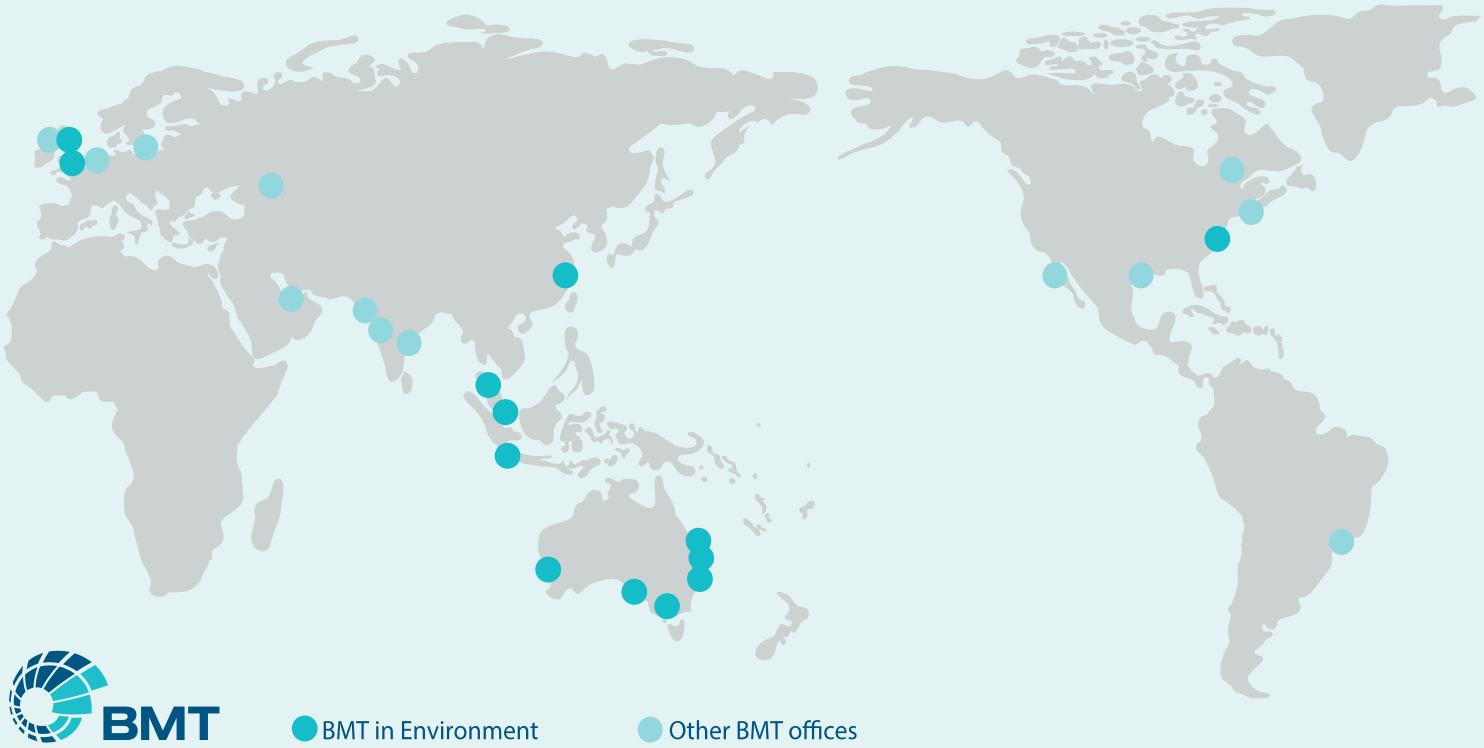

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