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ITEM 3 LAKE ILLAWARRA COASTAL MANAGEMENT PROGRAM (CMP) SUBMISSIONS IN REPLY REPORT AND CERTIFICATION

At its meeting on 22 July 2019, Wollongong City Council endorsed the draft Lake Illawarra Coastal Management Program (CMP) for public exhibition. The draft document was exhibited from 31 July to 11 September 2019. The exhibition resulted in 209 submissions from the community and 11 from NSW Government Agencies.

In response to the submissions a number of proposed changes have been made to the draft CMP, including the addition of several new actions to address issues such as dredging of the Lake and encouraging tourist opportunities. Other significant changes relate to the enhancement of actions for analysis and management of the entrance channel and Windang Bridge. These proposed changes have resulted in a significant increase to projected implementation costs.

For the CMP to be considered valid and able to access grant funding, it must be certified by the NSW Government and subsequently gazetted. This report recommends that Council adopt the proposed changes to the draft CMP and agree to submit it to the NSW Government for certification. A similar report will be considered by Shellharbour City Council on 7 April 2020.

RECOMMENDATION

1 The Submissions in Reply Report for draft Lake Illawarra Coastal Management Program be accepted.

2 The draft Lake Illawarra Coastal Management Program, as attached to this report, be adopted and submitted to the NSW Government for certification.

3 Wollongong City Council and Shellharbour City Council work in partnership to review and update the Memorandum of Understanding for Lake Illawarra to promote the collaborative and effective delivery of the Lake Illawarra Coastal Management Program.

REPORT AUTHORISATIONS

Report of: Chris Stewart, Manager City Strategy
Authorised by: Linda Davis, Director Planning + Environment - Future City + Neighbourhoods

ATTACHMENTS

1 Submissions in Reply Report for draft Lake Illawarra CMP
2 Marked up version of revised draft Lake Illawarra CMP
3 Revised Draft Lake Illawarra CMP
4 Lake Illawarra CMP 2020-2030 Snapshot
5 WCC - Projected Costings Lake Illawarra CMP

BACKGROUND

Management of Lake Illawarra

From 1988 to 2014, Lake Illawarra and its immediate surrounds were managed by the Lake Illawarra Authority (LIA). In July 2014, the LIA disbanded and its responsibilities were transferred to Wollongong City Council, Shellharbour City Council and a number of NSW Government Agencies.

Wollongong City Council subsequently resolved to enter into a Memorandum of Understanding (MOU) with Shellharbour City Council for the environmental management of Lake Illawarra. Under the MOU the Councils (in part) committed to -

- establish the Lake Illawarra Estuary Management Committee (LIEMC)
- the development and implementation of a strategic management plan for the Lake
- pursuing grant opportunities and encouraging collaboration between the two Councils

- a dedicated budget for the preparation of the strategic management plan, appointment of a Project Coordinator, monitoring and evaluation activities and implementation of activities that are of mutual benefit to the Councils.

Development of the draft Lake Illawarra Coastal Management Program

The development of a Coastal Zone Management Plan (CZMP) for Lake Illawarra began in 2015 in accordance with the relevant legislation at the time being a Coastal Zone Management Plan. However, in 2016 the NSW Government repealed the *Coastal Protection Act 1979* and passed the *Coastal Management Act 2016*. The new legislation required the development of a CMP, which identifies coastal management issues and provides a business plan for all proposed actions.

A Project Management Team with representatives from Wollongong City Council, Shellharbour City Council and the NSW Department of Planning, Industry and Environment (DPIE) has overseen the preparation of the draft Lake Illawarra CMP, with advice from the Lake Illawarra Estuary Management Committee (LIEMC). The LIEMC includes elected representatives from both Wollongong and Shellharbour City Councils, community and Aboriginal community representatives, independent scientific advisors and various State Agency representatives.

The Coastal Management Manual was released in 2018 which prescribes a five-stage process for developing a CMP. An outline of the CMP development process is provided in Table 1 below along with a description of the actions undertaken to date for the draft Lake Illawarra CMP.

Table 1 – CMP development process and progress for Lake Illawarra CMP

Stage #	Description	Actions for Lake Illawarra CMP	Status
1	Identify the scope of the CMP	A Scoping Study was prepared by staff in March 2017. It identified gaps in current scientific understanding and management arrangements for Lake Illawarra.	Complete
2	Determine risks, vulnerabilities and opportunities	The Lake Illawarra Information Synthesis Report was finalised in June 2019, providing a review of existing scientific information about the Lake and understanding of threats to estuary health. The Lake Illawarra Community Uses, Values, Threats and Opportunities Report (Values Report) was finalised in June 2019. This report consolidates the knowledge of key stakeholders and the community, to augment the information contained in the Synthesis Report. Seventeen threats to estuary health, including coastal hazard risks, were identified and assessed. Potential management actions to address these threats were also identified.	Complete
3	Identify and evaluate options	All potential management actions identified in the Synthesis Report and the Values Report in addition to those identified through an audit of existing management regimes were collated, reviewed and refined. They were then subject to a detailed multi criteria environmental benefit analysis as well as a cost-benefit analysis to determine the proposed management actions. At this stage 37 management actions under nine overarching strategies were identified for inclusion in the draft Lake Illawarra CMP from 212 potential actions.	Complete

Stage #	Description	Actions for Lake Illawarra CMP	Status
4	Prepare, exhibit, finalise, certify and adopt the CMP	The draft Lake Illawarra CMP was placed on public exhibition 31 July to 11 September 2019. 209 public submissions were received as well as 11 State Agency submissions. The analysis and proposed response to submissions and recommended process to finalise the CMP is the subject of this report.	In progress
5	Implement, monitor, evaluate and report	Subject to finalization, Wollongong and Shellharbour Councils will facilitate implementation of the Lake Illawarra CMP through the Councils' forward planning and budgetary processes under the auspice of the Integrated and Planning and Reporting (IP&R) framework of both Councils to undertake, track and measure the success of actions in the CMP.	Pending

As outlined above, the draft Lake Illawarra CMP is supported by the following documents developed during the CMP preparation process. These documents are not required to be a part of the certification process for the draft Lake Illawarra CMP -

- Lake Illawarra Coastal Management Program Scoping Study
- Lake Illawarra Information Synthesis Report
- Lake Illawarra Community Uses, Values, Threats and Opportunities Report
- Lake Illawarra CMP Management Actions Assessment.

Public Exhibition

Following endorsement by both Wollongong and Shellharbour Councils the draft Lake Illawarra CMP was placed on public exhibition for a period of six weeks from 31 July to 11 September 2019. It was available for viewing on the Wollongong and Shellharbour City Council websites and in all Wollongong and Shellharbour City Council libraries. Two community drop in sessions were held on 13 and 14 August 2019 in Dapto and Shellharbour respectively, to allow the community to ask any questions about the draft CMP.

Staff from all relevant sections of Council attended their respective drop in session as well as a representative from the State Government and a representative from BMT (who authored the draft Lake Illawarra CMP and supporting reports) to address community enquiries and concerns. Presentations were also made by Council staff to several Neighbourhood Forums and Committees. The CMP exhibition process was also promoted via TV news reports on WIN TV and ABC, on Local ABC radio and in print via the Illawarra Mercury, the Advertiser as well as both Council's websites and social media platforms.

Outcomes of exhibition

A total of 209 submissions were received from the community and 11 from NSW Government Agencies or other organisations. A petition with 190 signatures was also received answering the following question in the affirmative *"Do you object to dredging of the Lake's bays not being included in the LICMP?"*

All submissions were reviewed and analysed by the Project Management Team. A summary of the key issues raised and proposed response formulated by the Project Management Team is provided in Table 2 below. A more detailed analysis of the submissions and the proposed responses has been collated and documented in a draft Submissions in Reply Report, provided in Attachment 1.

Table 2 - Summary of issues raised during public exhibition and proposed response

Issue category	Issue	Summary	Proposed response
Common issue raised in ten or more community submissions	Dredging	Approximately two-thirds of all community submissions called for dredging within the Lake. The community concern, predominately originated from Shellharbour LGA residents, regarding the general shallowness of the water body and impact to use of recreational infrastructure.	2 new actions in the draft CMP: RA5 - allows for small scale dredging around recreational infrastructure RA6 - investigates the opportunities for larger scale 'bay wide' dredging.
	Importance of Tourism	More recognition of the value of Lake Illawarra as a tourism asset and call for better tourism outcomes.	1 new action in the draft CMP: RA4 - aligns current tourism planning to the outcomes of the CMP.
	Vegetation	Concerns regarding mangrove spread, support for mangroves and saltmarsh protection.	Minor changes
	Balance of issue in the CMP	Concern raised that the CMP was "too environmental" in focus and did not address social and economic issues sufficiently.	No change
	Fishing/ cockle collecting	Call for temporary or permanent bans due to overfishing.	Minor changes. All relevant comments provided to Dept of Fisheries.
	Recreational infrastructure	Requests for improvements to be made to benefit recreational usage.	Minor changes. Some comments referred to relevant sections of Council for action.
	Sediments and other runoff/ catchment development	Concern about catchment development without appropriate planning and management.	No changes
	Litter	Calls for better servicing of high use areas. Social / recreational use concerns as well as environmental concerns raised.	1 new action in the draft CMP: WQ8 – allows for increased bins and collection during peak periods and other items. Some other minor changes.
	Entrance management	Calls for better management of erosion and other entrance channel impacts due to the permanent opening and more comprehensive studies.	EC actions changed following NSW State Agency and Council staff review
Issue raised in less than ten community	Cultural Heritage		No changes
	Climate Change		No changes

Issue category	Issue	Summary	Proposed response
submissions	Engagement		Minor changes
	Monitoring		No changes
	Funding		No changes
	Thermal discharges		No changes
	Land acquisition		No changes
	Flooding		No changes
	Fauna		Minor changes

In the above context, “minor changes” reflect a clarification of wording or similar.

In addition to the changes proposed in response to the public exhibition process and addressed in the Submissions in Reply Report, staff have reviewed the draft Lake Illawarra CMP and have proposed a number of changes to produce a more effective document. Significant proposed changes include -

- the movement of most appendices in the exhibited draft into other parts of the CMP or into supporting documents
- the addition of an Executive Summary
- reorganisation and re-wording of entrance channel actions
- water quality / health monitoring actions that were spread across three actions (WQ7, 8 and 10) combined into one water quality/health monitoring action (WQ7)
- updated infrastructure works included in RA1
- reorganisation and rewording of entrance channel actions to better reflect short, medium and longer term actions
- Significant increase in projections for activities included in EC1 (medium term action estimates from $2-5M to $5-$10M and longer-term actions estimates from $10-20M to $15-$25M). The increase is a result of preliminary Council investigations and is considered to be a better reflection of the current understanding of projected costs.
- Significant increase in existing budgets for works within the entrance channel. The entrance channel is continuing to impact State and Council owned infrastructure including Windang Bridge and northern breakwalls. In the last six months this impact has been more apparent and required to be funded accordingly (eg Transport for NSW spending $2.5M in action EC3 to secure Windang Bridge).

The revised draft Lake Illawarra CMP now contains 39 management actions under nine overarching strategies. A copy of the previous draft CMP marked up with all proposed changes is provided in Attachment 2.

Increase in the estimated cost of CMP implementation

As discussed above, the estimated overall cost for implementation of the draft Lake Illawarra CMP has increased significantly, from $37.4M over 10 years to an estimated overall implementation cost of $72.8M over 10 years.

This increase is due to a number of factors –

- Higher estimated costing of some actions as a result of community demands and state agency and Council staff feedback

- The cost of additional actions - the inclusion of four new actions has incurred a projected cost increase of $1.53M
- Much higher revised projections for medium and long-term entrance channel management costs. This increase also reflects the addition of large existing State Government contributions and expected larger State Government contributions to Entrance Channel (EC) actions. Medium term action estimates increased from $2-5M to $5-$10M and longer-term actions estimates increased from $10-20M to $15-$25M.

Support of stakeholders

The revised draft Lake Illawarra CMP was presented to the LIEMC at their meeting held on 26 February 2020. The LIEMC unanimously passed a motion, as follows –

The LIEMC:

- *Supports the Lake Illawarra CMP Submissions in Reply Report*
- *Recommends that Wollongong City Council and Shellharbour City Council endorse the draft Lake Illawarra CMP be submitted to the Minister for Local Government The Hon. Shelley Hancock MP to consider it for certification.*

Formal letters of support are being sought from all stakeholders listed as either a responsible or supporting Agency within the CMP. These letters of support are a requirement under the *Coastal Management Act 2016* and will be included in the Council certification submission. At the time of report preparation, letters of support have been received from DPIE – Planning, DPIE – Crown Lands, DPIE – Coasts and Estuaries, National Parks and Wildlife Service and NSW Environment Protection Authority.

PROPOSAL

Adoption and delivery of a certified Lake Illawarra CMP is intended to provide strategic direction and specific actions to address threats to the Lake and to maintain ecological, social and economic values, to achieve ecological sustainability for Lake Illawarra over the long term.

As outlined in this report, following public exhibition of the draft Lake Illawarra CMP, proposed changes have been made to the document. A revised draft Lake Illawarra CMP has been produced (Attachment 3).

In addition, a draft brochure entitled *Lake Illawarra Coastal Management Program 2020-2030 Snapshot*, has been prepared (Attachment 4). The brochure summarises the draft Lake Illawarra CMP in plain English and is intended to assist with raising awareness and community engagement. The brochure will be finalised and circulated following certification and gazettal of the Lake Illawarra CMP.

It is therefore proposed that Council accept the Submissions in Reply Report and adopt the revised draft Lake Illawarra CMP to be submitted to the NSW Government for certification.

A similar proposal will be considered by Shellharbour City Council at their meeting on 7 April 2020. Both Councils need to agree to the proposal in order for the submission of the draft Lake Illawarra CMP to the Minister to occur.

If the draft Lake Illawarra CMP is submitted for certification at this time, it will be the first CMP in NSW submitted under the current framework, which is a major achievement for both Councils.

Given Lake Illawarra and its catchment span the Local Government Areas of Shellharbour and Wollongong Councils, it is imperative that the two Councils continue to work together to manage and protect the Lake. It is therefore recommended that the MOU between the two Councils be reviewed and updated to promote collaborative and effective delivery of the Lake Illawarra CMP following its certification and gazettal.

CONSULTATION AND COMMUNICATION

Extensive community engagement activities associated with development of the draft Lake Illawarra CMP have been occurring since mid-2015 with ongoing liaison with staff across both Councils, staff from relevant Agencies, the Lake Illawarra Estuary Management Committee, Neighbourhood Forum Groups the WCC Aboriginal Reference Group and the SCC Aboriginal Advisory Committee, in particular. All supporting documents underwent extensive stakeholder review during this period.

As discussed in this report, an extensive public exhibition process was undertaken to seek community and stakeholder feedback on the draft Lake Illawarra CMP. Submissions through this process have been considered by the Project Management Team and where appropriate proposed changes have been incorporated into the revised draft Lake Illawarra CMP recommended for certification.

The LIEMC is made up of elected officials from Wollongong City Council and Shellharbour City Council, State Government Agency representatives, independent scientific advisors, community representatives from both Wollongong and Shellharbour as well as Aboriginal representatives. The LIEMC has provided comprehensive input into the development of the draft Lake Illawarra CMP and has most recently reviewed the Submissions in Reply Report and the revised draft Lake Illawarra CMP. The LIEMC has unanimously provided formal support for both documents.

PLANNING AND POLICY IMPACT

This report contributes to the delivery of Our Wollongong 2028 goal 'We value and protect our environment'. It specifically delivers on the following –

Community Strategic Plan	Delivery Program 2018-2021	Operational Plan 2018-19
Strategy	**3 Year Action**	**Operational Plan Actions**
1.1.2 Manage and effectively improve the cleanliness, health and biodiversity of creeks, lakes, waterways and oceans	1.1.2.1 Protect and conserve the health and biodiversity of our waterways and coast	Prepare and implement priority actions of the Coastal Management Plan for Lake Illawarra

Ecological Sustainability

A strategic approach to the long-term management of Lake Illawarra is a prudent investment in the ecological sustainability of this important natural resource. The draft Lake Illawarra CMP aims to ensure that threats to the health and viability of the Lake are managed appropriately through the delivery of effective and targeted actions. It is crucial that the development and corresponding impacts to the Lake and its surrounds are planned and managed to sustain the Lake for future generations to value and enjoy.

RISK MANAGEMENT

Without a certified CMP the risks to Council and the community include -

- councils and agencies will be ineligible to apply for government grants for infrastructure and environmental improvement projects
- a continuation of piecemeal management of Lake Illawarra will result in poor estuary health, leading to loss of ecological value, recreational amenity and commercial opportunity (eg fishing and tourism).
- the uncoordinated management of Lake infrastructure and environmental assets.

The draft Lake Illawarra CMP recommends a management approach that will decrease these risks and encourage the coordinated management of the Lake.

Once certified, there will be a level of community and external stakeholder expectation regarding the delivery of actions within the CMP that will need to be managed.

FINANCIAL IMPLICATIONS

Adoption of the Lake Illawarra CMP does not of itself commit Council to implement the projects identified in it. Should the CMP be certified, Council is required to consider the list of agreed management actions in its forward planning and budgeting processes under the IP&R framework. Actions will be considered and where appropriate planned for and delivered through the four yearly Delivery Programs and yearly Operational Plans, including the preparation and consideration of business proposals.

Staff have reviewed the revised draft Lake Illawarra CMP and estimate the following projected costs for implementation of all actions, under the responsibility of Wollongong Council as follows –

- Year 1 (2020/21) ~ $2.1M
- Years 2-5 (2021/22 – 2024/25) ~ $13.4M
- Years 6-10 (2025/26 – 2029/30) ~ $15.6M

The total estimated implementation cost to Wollongong City Council is $31.1M over 10 years. More detailed information regarding the indicative costs to Wollongong City Council is provided in the 'Projected Costings Lake Illawarra CMP - Wollongong City Council' document (Attachment 5). It should be noted that this table does not form a part of the draft Lake Illawarra CMP, it is for Council's information only. The $31.1M potential costs for Council, detailed in the table, will be in part met through existing Council budgets. The information in this table does not account for these allocations or consider any other sources of potential funding, for example grant funding which can only occur once a CMP is certified.

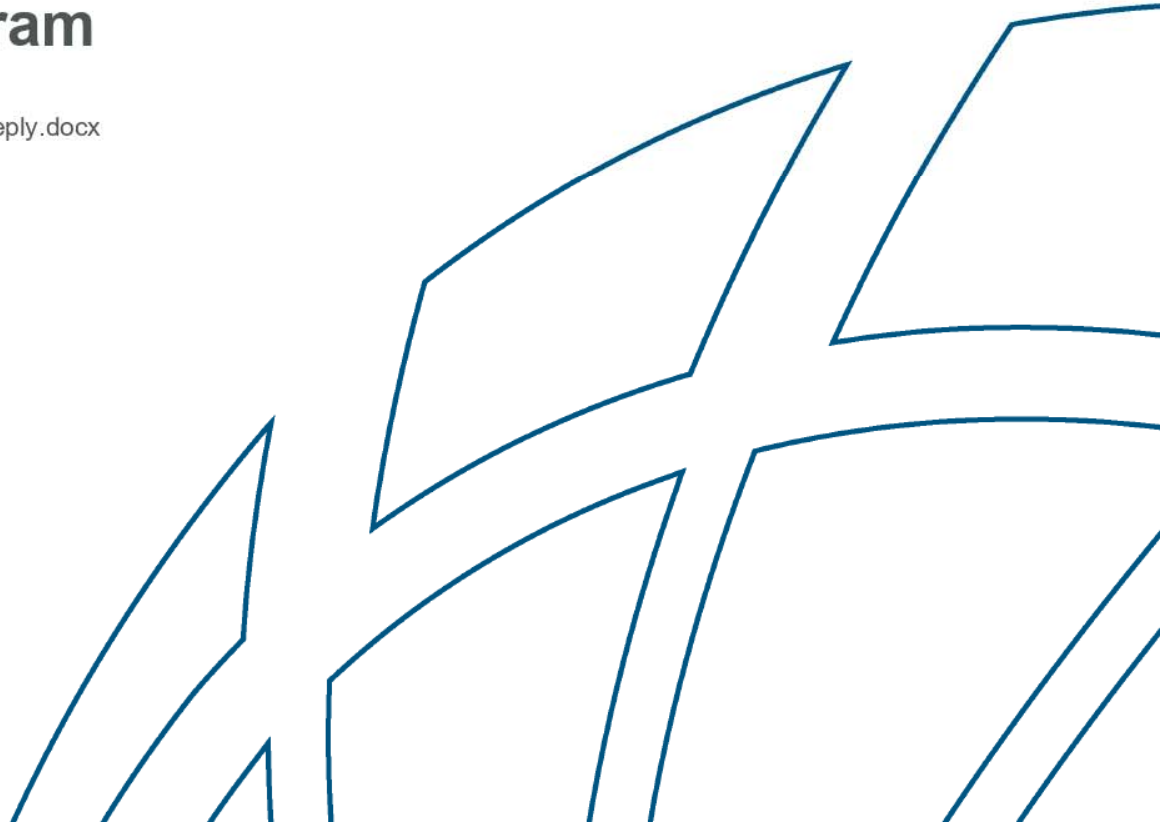
CONCLUSION

The draft Lake Illawarra CMP proposes a strategic approach to the long-term management of Lake Illawarra. The draft Lake Illawarra CMP has been developed over the last five years with the input of a vast array of stakeholders. More recently the document has undergone a public exhibition process attracting 209 submissions from the community and other stakeholders. In response to the issues raised and to improve the effectiveness of the future delivery of the CMP a number of changes are proposed to the draft Lake Illawarra CMP.

The revised draft Lake Illawarra CMP is therefore recommended to be submitted to the NSW Government for certification. Once certified, the Lake Illawarra CMP will guide the coordinated management and allocation of funds for Lake Illawarra over the next 10 years across Local Government, NSW Government Agencies and the community.

Submissions in Reply for Draft Lake Illawarra Coastal Management Program

Reference: R.N20606.004.02.SubmissionsInReply.docx
Date: February 2020



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Title	Submissions in Reply for Draft Lake Illawarra Coastal Management Program	**Client Contact**	Kristy Blackburn
Project Manager	Verity Rollason	**Synopsis**	This report details submissions on the Draft Lake Illawarra Coastal Management Program received during the public exhibition period, as well as the responses and proposed changes and actions in response to the submissions.
Authors	Verity Rollason		

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by		Issued by	
0	14 October 2019	VPR		VPR	
1	January 2020	VPR		VPR	
2	February 2020	VPR		VPR	

DISTRIBUTION

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	0	1	2	3	4	5	6	7	8	9	10
WCC & SCC	PDF	PDF	PDF								
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1 Submissions during Public Exhibition

1.1 Introduction

The Draft Lake Illawarra Coastal Management Program (CMP) sets the strategic direction and provides specific actions to address the threats to the Lake and to maintain the ecological, social and economic values of the Lake. Wollongong City Council (WCC) endorsed the public exhibition of this document on 22 July 2019, and Shellharbour City Council (SCC) endorsed the public exhibition of this document on 23 July 2019.

1.2 Public Exhibition Arrangements

The Draft CMP was placed on exhibition for a period of six weeks from 31 July to 11 September 2019. Two community drop in sessions were held on 13 and 14 August in Dapto and Shellharbour respectively to allow the community to ask any questions about the draft CMP. Staff from all relevant sections of Council attended their respective drop in session as well as a representative from the State Government and a representative from BMT (who authored the CMP and supporting reports) to address community enquiries and concerns. This allowed the community to gather information in order to make informed submissions. Presentations were also made to several neighbourhood forums and committees, as follows:

- SCC Aboriginal Advisory Committee on 16 July 2019;
- Neighbourhood Forum 8 (covering Kanahooka to Haywards Bay) on 14 August 2019;
- Neighbourhood Forum 7 (covering Berkeley to Windang) on 20 August 2019;
- WCC Aboriginal Reference Group on 28 August 2019; and
- Lake Illawarra Estuary Management Committee (LIEMC) on 28 August 2019.

1.3 Submissions Received

A total of 209 submissions were received from residents / general community and 11 from state government agencies or organisations. Residents around the Lake also submitted a petition with 190 signatures answering the following question in the affirmative *"Do you object to dredging of the Lake's bays not being included in the LICMP?"*. All submissions were reviewed and analysed by the Project Management Team (PMT) for the Lake Illawarra CMP, and a response prepared through this report.

1.4 Response to Community Submissions

In order to respond to the large number of submissions received, the submissions / concerns raised within a submission were grouped based on the concerns or issues raised in the submission.

The number of submissions on a specific concern and / or number of times a concern was raised (for instances where a submission contained more than one concern) were then counted. Based on this, a total of nine issues that were raised 10 or more times were defined. The remaining concerns raised were tabulated together and given a specific response. The issues, the PMT's response to each issue and any proposed changes required to the CMP are detailed in the following sections and tables.

1.4.1 Issue 1: Dredging

An action for dredging in the Lake was assessed as part of the multi criteria analysis of CMP actions, but did not score high enough to be selected as an action for implementation in the public exhibition draft CMP.

During public exhibition there was considerable community demand for a dredging action to be included in the CMP, predominantly from the Shellharbour community. The submissions can be grouped into two broad categories. Minor dredging to better enable the use of specific pieces of recreational infrastructure due to perceived/ actual increase in sedimentation in the local area around them, and the need for larger scale dredging of whole or part bays and creek entrances to address a general shallowness.

It is noted that the legacy from past sedimentation occurring in the Lake is a big concern to the community due to its impact on the recreational usage and amenity of the Lake. Urban development undertaken around the Lake fringe and catchment has resulted in large quantities of sediment running off and depositing in the Lake. Under past management regimes for the Lake (such as the Lake Illawarra Authority (LIA)), the community has a perception that dredging to remove this sediment is going to occur. Permanent opening of the Lake has exacerbated the perception that the Lake is getting shallower, because the permanent opening has lowered average Lake water levels and resulted in a lower low tide water level (noting that the high tide level is also higher). Lower average and low tide water levels are perceived by the community as a shallowing of the Lake, increasing the community concern over Lake sedimentation and therefore the community impetus for dredging. The substantial costs and potential negative impacts of dredging have negated large scale dredging in the Lake in the past, and this was reflected in the low scoring for the dredging action in the public exhibition draft CMP.

There are potentially substantial negative impacts from dredging within the main water body and smaller bays and tributaries of the Lake that need to be well understood and avoided, should any dredging be pursued, as outlined below.

- The financial costs of dredging are very high, with the estimated costs quoted in the public exhibition draft of the CMP based on previous dredging designs and investigations (as documented in the prior LIA draft CZMP). The true costs can only be ascertained with detailed analysis of a proposed dredging campaign.
- Dredging may remove high quality habitat for fish and other animals (e.g. seagrass, saltmarsh, wetlands), which in turn affects recreational and commercial fishing in the Lake.
- Sediment plumes from dredging can smother seagrass beds, which as noted above will affect fish stocks.
- Dredging in areas of past contamination may re-mobilise the contaminated sediments into the water column, where the contaminants are then consumed by fish and other animals. The consumed contaminants either directly harm fish and other animals, or bioaccumulate to be consumed by humans through recreational and commercial fishing.
- Similarly, dredging may expose lower sediment layers that contain acid sulphate soils that, once exposed to the air, oxidise and can release highly acidic water into the environment, again affecting plants and animals nearby.
- The dredged material (sediment, muds, clays etc) removed from the Lake needs to be disposed of carefully, particularly where this material contains contaminated soils, or acid sulphate soils, both of which cannot simply be placed on nearby land as fill without treatment. The exposure of such soils

to oxygen causes chemical reactions that result in acid and other toxic run off from these soils. If contaminated dredge spoil cannot be easily treated and reused, then it would need to be disposed of as hazardous waste to landfill, which is very expensive (e.g. ~$400 / tonne + collection and transport costs).

- There are also traffic impacts to be managed, for trucking contaminated dredge spoil from the site to the landfill and / or for trucking the clean dredge spoil to the chosen disposal / fill site (which will presumably be on land given the concerns over sedimentation and shallowing in the Lake).
- A short term storage area may also be required where there is a lag between dredging material from the Lake, and transporting it to landfill/disposal site. Runoff, dust, and erosion sediment control would be required for the short term storage site.

Taking into consideration the community demand as well as the environmental and technical limitations two new actions are proposed (RA5 and RA6). RA5 will allow small scale dredging to improve public recreation access with appropriate approvals and RA6 will investigate the viability of larger scale dredging of bays.

1.4.2 Issue 2: Importance of Tourism

An action relating to Tourism was assessed as part of the multi criteria analysis, but did not score high enough to be selected as an action for implementation in the public exhibition draft CMP. The overwhelming support for enhancing and improving opportunities for Tourism in an around the Lake that were evident in the submissions has indicated that, while not strictly the main priority of a CMP, an action is needed in the CMP to support and facilitate improvements in Tourism opportunities specific to the Lake.

RA4 has been added that directs Councils and Tourism management agencies to work together in order to build on the tourism opportunities for the Lake.

1.4.3 Issue 3: Vegetation Management

Comments concerning vegetation management covered a range of subjects, including concerns about and support for mangroves around the Lake. Although previously not widely distributed, mangroves are not new to the Lake. They were recorded in surveys undertaken in the 1970/80's. However, they have spread since the permanent entrance opening. The permanent opening has resulted in much larger tidal variations and a more saline environment, which is what mangroves require to survive, thrive and populate new areas. The spread of mangroves can be considered a natural response to the changes brought on by the permanent entrance opening.

Saltmarshes have always been present in the Lake, and this habitat can be squeezed out between the foreshore and urban development if not properly managed. At several locations on the rim of the Lake, saltmarshes can be seen to grade into dense stands of Coastal Swamp Oak (*Casuarina glauca)*[1](commonly termed "Casuarina"). Coastal Swamp Oak is listed as an Endangered Ecological Community that naturally occurs in estuarine environments, and as such is a valuable part of the Lake Illawarra environment.

The concerns of the public are therefore noted, and the current public exhibition draft CMP contains a range of actions to rehabilitate and manage riparian and estuarine vegetation. This includes actions to cater for both the

[1] NPWS (2002). *Native Vegetation of the Illawarra Escarpment and Coastal Plain*. Available at: "https://www.environment.nsw.gov.au/resources/nature/surveys/020107NatVegIll.pdf"

migration and ongoing protection of saltmarshes, while also supporting mangrove habitats as appropriate.

1.4.4 Issue 4: Balance between Social, Environmental and Economic Issues and Actions

Concerns were raised by some of the community that the plan is too focussed on actions that are environmental in nature, with not enough focus on recreational benefits. While the number of actions directly relating to environmental issues may be greater than recreational actions, the actual cost breakdown for spending on actions in the CMP demonstrates that more funding will be allocated towards recreational actions, as shown in Figure 1-1 and Figure 1-2. It is further noted that supporting the environmental quality and ecological health and functioning of the Lake directly benefits the community, because it is the high environmental quality of the Lake that brings about its high recreational value. Therefore, the concerns from submissions have been noted and addressed below, with no changes to the CMP required.

1.4.5 Issue 5: Fishing and Cockle Collecting

Issues relating to fishing and cockle collecting in the Lake are the sole responsibility of the Department of Primary Industry – Fisheries (DPI Fisheries), who have jurisdiction over the relevant legislation, regulations and policies that cover commercial and recreational fishing, including hand gathering activities such as collecting cockles. The public exhibition draft of the CMP therefore does not have any direct management actions relating to cockle collection, but does include actions to assist DPI Fisheries in their management of this issue, in recognition of the high community concern relating to cockle gathering.

The many submissions relating again to commercial fishing and cockle collecting have been noted. All fishing related submissions will be sent to DPI Fisheries as the management authority for such concerns. Action PM1 has been added to in order to demonstrate support for the Councils providing submissions to DPI Fisheries relating to the issue.

1.4.6 Issue 6: Recreational Infrastructure

Submissions regarding recreational infrastructure were predominately requests for more facilities / infrastructure, provision of better disabled access, and then specific types of assets and specific locations.

The public exhibition draft CMP contains two actions relating to maintaining and improving recreational access, facilities and amenities. One such action specifically involves providing new access and facilities around the Lake, in locations determined through a lake-wide audit and program (Action RA1). Therefore, the CMP already addresses adequately the requests for new/additional infrastructure, and the specific facilities / locations discussed in submissions will be noted when determining where and when to upgrade / install new recreational infrastructure. Those submissions relating to specific maintenance requests have been passed onto the manager for action as relevant.

The wording of Action RA1 has been amended to specifically include provision of disabled access as a requirement when designing new/ upgrading facilities.

1.4.7 Issue 7: Sediments, Contaminants and Other Pollutants in Runoff

The community raised concerns about sediment and contaminated sediment entering the Lake from uncontrolled urban development (during and after construction), industrial development, and runoff from roads. The public exhibition draft CMP contains a number of actions to manage these concerns and no changes are considered necessary.

Submissions during Public Exhibition

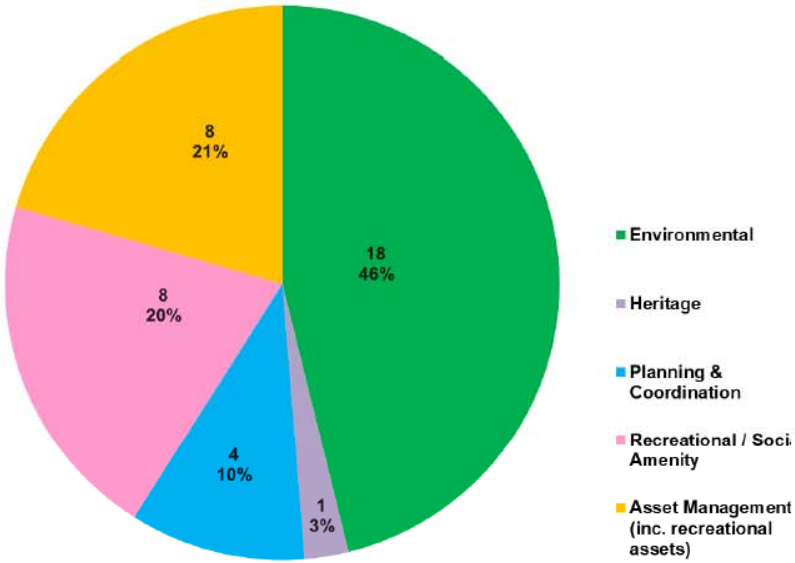

Figure 1-1 Number of Actions by Action Type in the CMP

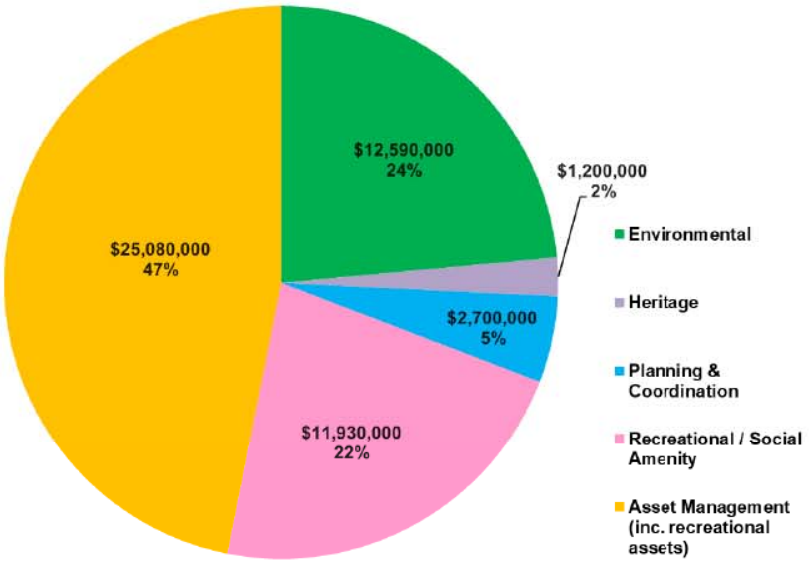

Figure 1-2 Cost Allocation by Action Type in the CMP

1.4.8 Issue 8: Litter

The community raised many concerns regarding litter and rubbish entering the Lake. Submissions from local community groups and neighbourhoods noted a recent wind event that blew large quantities of polystyrene waffle pods (which are used to set foundations in new constructions) across the natural environment. The spread of polystyrene was very extensive, worsened by the fact that many of the waffle pods had broken into smaller pieces. Some groups returned more than three weeks after the wind event to find large quantities of polystyrene still remained spread across the environment.

Other submissions related to the large quantities of rubbish that had been washed into the Lake, including shopping trolleys. The community questioned the effectiveness of current stormwater controls and maintenance considering the size and quantity of litter they had collected.

The public exhibition draft CMP does contain a number of actions to improve the effectiveness of current and future stormwater management, and maintenance of controls. Suggestions from the community regarding clean up days have been incorporated into existing actions.

A new action (WQ8 – Improve litter management) has been added to the CMP to address the above litter issues, supporting the councils to provide more bins and collections in summer, compliance programs to reduce illegal dumping and support clean up days/ rubbish removal twice a year in key locations.

1.4.9 Issue 9: Entrance Management

There have been substantial changes and issues occurring within the entrance channel to Lake Illawarra after the entrance was permanently opened in 2007. Community concerns have therefore been raised regarding the impacts of entrance opening, and what actions will be taken to address the impacts. The public exhibition draft contains a specific Entrance Management strategy with five actions relating to managing entrance channel changes that adequately addresses these concerns.

1.4.10 Remaining Issues and Concerns

For issues / concerns raised less than 10 times, the issue, number of times raised and response to the submission is contained in the following table.

Submissions during Public Exhibition

Table 1-1 Summary of Concerns Raised in Community Submissions During Public Exhibition and Proposed Response

Issue No.	Issue	# of Sub-missions	Key Comments / Concerns	Key Locations of Concern	Response	Proposed Changes
1	**Pro-dredging**	137 (+ 190 signature petition)	• Past sedimentation (e.g. during urban development in 1970s-80s) shallowed Lake and was never remediated. • Navigability for boats / accessibility for recreation • Bridgeworks have narrowed flow • Permanent opening bringing in sediments • Local clubs should be able to dredge their area • Add a second entrance • Use spoils to reclaim land/ make bird islands • Perceived health of smaller bays due to sedimentation	• Reddall Parade • Entrance back channel • Boat Ramps • Bays • Sailing Clubs • Skiway Park • The central area • Hooka Creek and tank trap	Recognising the community's high level of concern over the recreational amenity of the Lake, a new action has been drafted to allow for small scale dredging in key locations, to improve recreational amenity, provided negative environmental impacts can be avoided. Past sedimentation issues are acknowledged, noting that the system has also adapted to the past sedimentation, with new areas of high quality habitat for fish and other animals. Permanent opening of the Lake has exacerbated the perception that the Lake is shallowing further, because the permanent opening has lowered average Lake water levels, and also resulted in a lower low tide water level.	Two new actions have been drafted to be included in the Recreational Amenity strategy in the CMP: • Action RA5 – Conduct small scale dredging to improve public recreational outcomes and to improve the functionality of stormwater outlet infrastructure, on an opportunistic and justified basis and all required environmental assessments and approvals. • Action 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.
	Anti- dredging	13	• Maintain ecological function and carbon sequestration • Risk of disturbing contaminated sediment too high, water quality will suffer	*N/A*	Concerns raised in public exhibition about the impacts of dredging have been taken into account in drafting the new dredging action (refer Section 1.4.1 for potential impacts).	As above, two new actions have been drafted to be included in the Recreational Amenity strategy within the CMP (as RA5 and RA6). The new actions state clearly that any dredging undertaken must minimise/ avoid negative environmental impacts. The potential for impact and any mitigative / avoidance controls would be determined on a case by case basis as part of standard environmental approvals for any dredging episode.

Submissions during Public Exhibition

Issue No.	Issue	# of Sub-missions	Key Comments / Concerns	Key Locations of Concern	Response	Proposed Changes
2	**Importance of Tourism**	50	• More cafes, kiosks, jetties • General upkeep • Cruises • Floating restaurant • Complete cycleway • Boat hire • Swimming areas – deeper water • Playgrounds • Heritage list the Lake • Give back King St • Develop a tourism strategy	• On and in the Lake	The overwhelming support for enhancing and improving opportunities for Tourism in an around the Lake has been acknowledged, and a new action developed as a response (see proposed changes). Tourism Shellharbour and Destination Wollongong are supportive of the new action.	An action has been drafted and is proposed to be included in the Recreational Amenity strategy within the CMP, namely RA4 – Build on the Tourism opportunities for Lake Illawarra. The action aims to further develop and achieve common Tourism goals across the Lake and link the outcomes of the CMP to the Destination Management Plans. As a CMP action, there is access to a wide array of funding mechanisms and technical support.
3	**Anti - vegetation**	37	• Control mangroves • Plan of Management for mangroves • Don't plant mangroves • Control *Casuarinas* • Mangroves, saltmarsh and seagrass are all important • Access issues due to vegetation	• Parks • Foreshore • Koona Bay	The community concerns regarding mangroves are noted. The public exhibition draft CMP has a Protect and Rehabilitate Estuarine and Riparian Vegetation Strategy under which there is an action for monitoring saltmarsh and mangrove extents (EV4) and reducing mangrove impacts if required. There is also an action for enhancing opportunities for saltmarsh migration and protection over time (EV5). These actions adequately address the community concerns raised. Council manage vegetation from a community safety perspective, and this adequately manages casuarina impacts and access issues. It is important to note that Council does not plant mangroves.	Update Action EV4 to include wording "and develop a mangrove management plan if necessary".
	Pro - vegetation	11	• Importance of mangroves, saltmarsh and seagrass • Plant more mangroves • Protect mangroves • Plant shade trees in parks • Control pests that feed on vegetation • Increase bushcare / landcare support • Return grassy foreshore parks to a more natural condition	*N/A*	The community support for improving Lake vegetation is noted. The public exhibition draft CMP includes the Protect and Rehabilitate Estuarine and Riparian Vegetation Strategy that contains five actions relating to rehabilitation and protection of riparian and estuarine vegetation, including mangroves, saltmarsh and seagrass. Planting shade trees in parks and reverting grassed areas are addressed in Community Land Plans of Management. These suggestions can be addressed as such plans are reviewed.	None required.

Submissions during Public Exhibition

Issue No.	Issue	# of Sub-missions	Key Comments / Concerns	Key Locations of Concern	Response	Proposed Changes
4	**Balance is too environmental**	36	• CMP is too environmentally focussed	*N/A*	The CMP has tried to strike the appropriate balance between environmental and social issues. In particular, it is noted in the CMP that supporting high environmental values of the Lake directly underpins the high recreational values associated with the Lake. A review of the breakdown of costs between recreational / social, environmental, and other actions provided in Section 1.4.4 demonstrates that: • Around a quarter of CMP action costs will be spent on recreational amenity actions; • Just under half of CMP action costs will go towards asset management for recreational and other assets that provide a community benefit; and • Around one quarter of CMP action costs will be spent on environmental actions, although many of these are water quality actions that will also directly benefit recreational outcomes. New actions for Dredging, Tourism and Litter are proposed in the CMP in response to community concerns. These new actions have direct and indirect social and recreational benefits. The new actions are included in cost breakdown described above.	While the response here recognises that the CMP has tried to strike the appropriate balance between environmental and social issues., it is further noted that, following public exhibition, a further four actions have been added that directly or indirectly provide recreational / social benefit to the Lake community. Three of the four actions were added to the Recreational Amenity strategy (being RA4, RA5 and RA6 as outline above) and one action in the Water Quality strategy (being WQ8 to improve litter management).
	Balance should be more environmental	<10	• CMP is not environmentally focussed enough	*N/A*	The CMP has tried to strike the appropriate balance between environmental and social issues. The CMP has determined actions to mitigate the high environmental risks to the Lake's health. In this regard, the plan has a greater number of actions for environmental issues than other issues, although the budget required is smaller.	None required.

Submissions during Public Exhibition

Issue No.	Issue	# of Sub-missions	Key Comments / Concerns	Key Locations of Concern	Response	Proposed Changes
5	**Fishing**	23	• Ban commercial fishing • Limit commercial fishing • Fish sustainably	*N/A*	DPI Fisheries have sole responsibility over commercial and recreational fishing, including hand gathering activities such as collecting cockles in the Lake. All submissions relating to this issue will be forwarded to DPI Fisheries.	None required.
	Cockle Collecting	10	• Ban cockle collection • Ban cockle collection for 2 years	*N/A*	DPI Fisheries have sole responsibility over commercial and recreational fishing, including hand gathering activities such as collecting cockles in the Lake. All submissions relating to this issue will be forwarded to DPI Fisheries. Action PM1 should be updated to promote Councils continued support for submissions to DPI Fisheries / NSW Government regarding cockle collection. The public exhibition draft CMP contains the following responses to cockle collection. Action EV2: Undertake targeted action to control damage to foreshore and Lake vegetation, including seagrasses, caused by hand gathering (e.g. cockles etc). Additional staff resources for compliance: $80,000 p.a. (shared across both Councils each year for 10 years). Action MF1: 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. $20,000 (consultancy) per ecological survey and analysis.	Update action PM1 details to include "continue to support / promote Council submissions to state government on key lake issues e.g. cockle collection, legislation around waffle pods, etc"

Submissions during Public Exhibition

Issue No.	Issue	# of Sub-missions	Key Comments / Concerns	Key Locations of Concern	Response	Proposed Changes
6	**Recreational Infrastructure**	26	• Fix the jetty • Make the Lake wheelchair accessible • Improve lighting/footpaths • More toilets and picnic facilities on the western side • Kiosks, jetties, cafes • Night food market at King St • BBQ's • Fix storm damage at Skiway Park • More parklands and gardens • Designated swimming areas • More swimming areas on the western side • Boating opportunities • Maintain infrastructure • Enhance for birdwatching • Develop an Accessibility Map for the Lake	• Deakin Reserve Jetty • Purry Burry Jetty • King St • Skiway Park • Northern Breakwall • Heritage Park	The comments are noted and concerns raised regarding specific assets and infrastructure have been referred to the relevant Council for action. Action RA1 is considered to adequately address the concerns raised in submissions regarding the provision of new/upgraded recreational facilities, as the action involves providing new access and facilities around the Lake, in locations determined through a lakewide audit and program. Submissions relating to specific types/ locations of assets have been noted for consideration when implementing Action RA1. With regard to provision of disabled access, Action RA2 already includes this provision. A minor wording change to RA1 is required to state outright that this needs to be provided.	Update Action RA1 to include provision of disabled access as a requirement when designing new/ upgrading facilities.

Submissions during Public Exhibition

Issue No.	Issue	# of Sub-missions	Key Comments / Concerns	Key Locations of Concern	Response	Proposed Changes
7	**Sediment and other pollutants in runoff**	23	• Albion Park roadworks • Industrial contamination • Development runoff • Erosion and sedimentation controls • Road runoff • Support mitigation efforts • Control by plantings, deer control and sustained maintenance	• Macquarie Rivulet • Horsley Creek • Slater's Bridge - Koona Bay • Tullimbah • Calderwood • Haywards Bay • Minnegang Creek	The concerns regarding sediments and other pollutants in runoff from roadworks, industrial land, construction zones and roads are duly noted. The public exhibition draft CMP already contains actions specifically targeted towards controlling and improving run off water quality, including: Action WQ1: involves applying a new Risk-based framework to catchment and sub-catchment based management of urban runoff from new (and potentially existing) development. From this, Action PM1 requires the update of DCPs and relevant consent conditions to specify the nutrient/sediment load reduction targets consistent with outcomes of WQ1. Action WQ2: involves upgrades to existing stormwater quality management measures, or installing new devices, monitoring of devices to determine their performance in reducing nutrients, sediments etc in runoff, and using evidence base for future new/replacement devices. Action WQ3: involves improving maintenance for stormwater quality devices, which will improve their ability to remove sediment, litter etc. Action WQ4: involves targeted monitoring of nutrients and sediments in runoff before, during and after developments. Action WQ5: aims to reduce sediment load to the Lake by improving compliance with erosion & sediment controls for development sites, with a range of measures to provide for improved compliance. Action WQ9: shall investigate and manage potential pollution sources including contaminated sites.	None required. Key locations noted by the community are recommended for priority in Councils' operational plans.

Submissions during Public Exhibition

Issue No.	Issue	# of Sub-missions	Key Comments / Concerns	Key Locations of Concern	Response	Proposed Changes
	Catchment Development	5	• This is the main threat • Tighter policing of building sites • More wetlands to catch/filter	• West Dapto • Tallawarra • Calderwood	It is agreed that catchment development, if uncontrolled, is a main threat to the Lake's health and values. A number of actions relate to managing catchment development (see above). Most notably Action WQ1 that involves applying a Risk Based Framework to managing the waterway health impacts of development, and Action PM1 that involves updating the Councils DCPs to improve outcomes from new developments.	None required.
	Contamin-ation	1	• WQ9 to include all potential contamination sources • Withhold development approval until sites are remediated.	*N/A*	The concerns regarding contamination are already covered by Action WQ9, which involves investigating and managing potential pollution sources including contaminated sites. Supporting documentation to the CMP includes a listing of contaminated sites. The list is maintained on the EPA's website. The development approval process already requires remediation of contaminated sites prior to development.	None required.

Submissions during Public Exhibition

Issue No.	Issue	# of Sub-missions	Key Comments / Concerns	Key Locations of Concern	Response	Proposed Changes
8	**Litter**	12	• Push for legislation against waffle pods • More bins in summer months • More clean ups • Council to support clean ups / remove rubbish • Raise awareness • Manage illegal dumping • Rubbish in creeks	• Foreshore • Koona Bay • Horsley Creek • West Dapto	Concerns raised by the community have been carefully noted. A number of actions in the public exhibition draft will assist to manage this issue, for example WQ1 (new stormwater management devices), WQ2 (upgrades to existing stormwater devices) and WQ3 (improved maintenance and cleaning of stormwater devices). Existing action PM3 does involve community engagement and activities relating to key values and issues in Lake Illawarra. This action should be amended to specifically note litter and illegal dumping as a key issue, with support for existing community groups in litter removal days, and raising community awareness on the issue. WCC has already sent a submission to the NSW Government regarding the impacts of waffle pods. Existing action PM1 should be amended to promote further submissions by the councils. A new action is proposed in the CMP to specifically require Councils' support for more bins and litter collection in summer, and clean up days / rubbish removal 1-2 times per year (e.g. before and after the summer months), see proposed changes.	Update Action PM3: • add to title "and implement". • add to details "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 (similar to the Rise and Shine Program)"; and • add to details regarding education program "e.g. relating to litter and plastics, illegal dumping". Update action PM1 details to include "continue to support / promote Council submissions to state government on key lake issues e.g. cockle collection, legislation around waffle pods, etc". An action has been drafted and is proposed to be included in the Water Quality strategy within the CMP, namely WQ8 – Improve litter management, supporting the councils to provide more bins and collections in summer, compliance programs to reduce illegal dumping and support clean up days/ rubbish removal twice a year in key locations.
9	**Entrance Management**	10	• Close the entrance • Conduct tracer study • Do not conduct tracer study • Make 'close the entrance' an option in the management options.	• Entrance Channel	Concerns raised by the community are noted. Action EC1 addresses these comments and will involve the consideration of entrance closure as a long term option.	None required. It is noted that changes are proposed to Entrance Channel Strategy actions to better separate short and long term responses, based upon the investigations and knowledge regarding entrance channel processes.

Submissions during Public Exhibition

Issue No.	Issue	# of Sub-missions	Key Comments / Concerns	Key Locations of Concern	Response	Proposed Changes
Remaining Issues	**Cultural Heritage**	6	• Pay aboriginal consultants • Aboriginal heritage officer employed must be indigenous • More consultation with indigenous peoples • Too much focus on cultural heritage	*N/A*	Concerns raised have been noted, and have been communicated to the Councils for consideration and inclusion in their policies. It is noted that considerable consultation with Aboriginal representatives in particular via the LIEMC, the WCC Aboriginal Reference Group and the SCC Aboriginal Consultative Committee has occurred through the course of developing the CMP and will continue to occur as the CMP is finalised, certified and implemented.	None required.
	Climate Change	5	• Increase current risk rating to high • Lake is a carbon sink	*N/A*	Rating of the climate risk is assessed in the plan to become high by 2040. Changes in Lake water levels due to the entrance channel are currently occurring at a far faster rate and pose a greater current threat. Climate change, particularly sea level rise, will exacerbate the current risks relating to inundation in the Lake. It is noted that the Lake may be a carbon sink, but this will not assist in managing Lake water level rises associated with entrance opening and sea level rise.	None required.
	Engagement	5	• More community events • Integrate action PM3 into school curriculum • Workshops e.g. saltmarsh plant ID • Committee decisions shared more with public • Include education on cultural heritage, casuarinas, plastic pollution etc	*N/A*	Community concerns have been noted, and Action PM3 certainly provides for more community events, schools collaboration, workshops and sharing of LIEMC decisions and outcomes. The wording of Action PM3 should be edited to include the specific areas of interest raised in submissions, i.e. saltmarsh identification, litter and plastic pollution, cultural heritage and casuarina values.	Update Action PM3 to include areas of interest raised in submissions, i.e. saltmarsh identification, litter and plastic pollution, cultural heritage and casuarina values.

Submissions during Public Exhibition

Issue No.	Issue	# of Sub-missions	Key Comments / Concerns	Key Locations of Concern	Response	Proposed Changes
	Monitoring	5	• Develop a report that summarises all water quality data so far • Make WQ data available to the public • Monitor for microplastics • Ensure most up to date data is used • Monitor to see results / progress of CMP	*N/A*	Summary reports of water quality data to date are updated yearly and are already available to the public. Water quality (and other) monitoring is already conducted in the Lake in accordance with current standards, such as the MER program. The public exhibition draft CMP contains actions to continue ecological health monitoring (Action WQ7) and undertake monitoring of physico-chemical and bacteriological parameters (Action WQ10), recreational water quality monitoring (Action WQ8) and site specific development monitoring (Action WQ4), as well as mapping of estuarine macrophytes (Action EV4), water level monitoring (Action IR4), entrance channel bathymetry (Action EC4) and Lake bathymetry (Action FB3). All of this monitoring provides a picture of the Lake's health, and will assist with determining the effectiveness of the CMP. It is noted that former actions WQ7, WQ8 and WQ10 are to be combined to make the process for Lake monitoring clearer to the community. The water quality monitoring program will be updated for micro plastics when recommendations are provided by the appropriate state agency(s).	None required. Micro plastic monitoring will commence when guidelines become available to the councils.
	Funding	3	• State Government funding not guaranteed • Dredging funding should not compromise funding for other actions • Funding should reflect community values	*N/A*	Community concerns are noted. The new NSW Government process for CMPs requires much stronger commitment from the Councils and state agencies responsible for implementing a CMP's actions. This is intended to greatly increase the implementation of actions.	None required.
	Thermal Discharges	2	• Bring back WQ Action relating to managing thermal discharges from Tallawarra	• Tallawarra Power Station	Community comments are noted, however, thermal discharges are already adequately managed by the EPA and Energy Australia through an Environment Protection Licence.	None required.

Submissions during Public Exhibition

Issue No.	Issue	# of Sub-missions	Key Comments / Concerns	Key Locations of Concern	Response	Proposed Changes
	Land Acquisition	1	• Bring back EV Action relating to land acquisition	*N/A*	The concerns of the community are noted, however, the land acquisition intent and actions from this former EV action have been incorporated into Action EV5 that is currently in the CMP.	None required.
	Flooding	1	• Build a defined shoreline to stop flooding	*N/A*	Actions relating to flooding are already managed through the councils Floodplain Risk Management Plan for Lake Illawarra. Tidal inundation risks, including relating to permanent opening of the Lake and climate change, are managed through the Inundation Risk Strategy and actions in the CMP. The Inundation Risk actions will consider the full range of options to mitigate inundation risks.	None required.
	Fauna	1	• Include current bird species list in CMP (and other fauna) • Improve habitat elsewhere if lost to development • Declare Ash Ponds as bird sanctuary	*N/A*	Community concerns and comments are duly noted. Bird and fauna species listings are contained in supporting documentation to the CMP, and are also held through other state government websites. There is already a legislated process for biodiversity offsetting for new developments. Changes to Action MF1 are recommended to capture the ability to improved land protections for bird habitat (such as through rezoning etc).	Update Action MF1 to pursue improved environmental protections for land containing bird habitat, where appropriate.

2 Agency and Other Organisation Submissions

2.1 Introduction

The following agencies and organisations provided comment on the public exhibition draft CMP:

- Department of Planning, Industry and Environment – Environment and Energy Services (DPIE – EES) – Coasts and Estuaries Branch;
- Department of Planning, Industry and Environment (DPIE – EES) – Policy and Legal Branch;
- Department of Primary Industries – Fisheries (DPI Fisheries);
- Department of Planning, Industry and Environment – Environment Protection Authority (EPA);
- Department of Planning, Industry and Environment – Crown Lands (DPIE – Crown Lands);
- Department of Planning, Industry and Environment – National Parks and Wildlife Services (NPWS);
- South Coast Local Land Services (LLS);
- Property NSW;
- Sydney Water;
- Energy Australia; and
- National Parks Association of NSW (NPA) Illawarra Branch.

2.2 Response to Submissions

A summary table summarising the comments received and the proposed changes to the CMP in response to these comments is provided in Table 2-1.

Agency and Other Organisation Submissions

Table 2-1 Summary of Agency and Other Organisation Submissions During Public Exhibition and Proposed Response

Organisation	Comment	Response	Proposed Changes
DPIE – EES Coasts and Estuaries	EES - Coast and Estuaries provided detailed editorial comments on the draft CMP, which were contained in a marked up pdf document.	Yes, the recommended changes are accepted.	Update CMP to incorporate EES Coast and Estuaries Branch's editorial comments.
DPIE – EES Policy and Legal	The Legal Department reviewed the CMP against the mandatory requirements for CMPs that are legislated in the *Coastal Management Act 2016* and the Coastal Management Manual (OEH, 2018). Changes were requested to ensure that the Lake Illawarra CMP meets these mandatory requirements.	Yes, the recommended changes are accepted.	Update CMP to incorporate DPIE Legal's recommended changes.
DPI Fisheries	Requests to be a 'supporting' rather than primary responsible organisation for action EV2. DPI Fisheries have committed assistance where required in providing: • management advice; • review of and contribution to policies, plans, targeted actions, signs and education material; • compliance action; • dissemination of education material; and • negotiating actions with other agencies	Yes, this change is accepted.	Update Action EV2 to list DPI Fisheries as 'supporting' rather than 'responsible' for implementation.
DPI Fisheries	DPI-Fisheries indicated that they have recently completed some mapping of estuarine vegetation within Lake Illawarra. The trends in marine vegetation distribution from the mapping done to date will be examined as part of a Marine Estate Management (MEM) Strategy project.	This information should be included as 'further information' within Action EV4.	Update Action EV4 to state in further information that 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.
DPI Fisheries	DPI-Fisheries provided the following wording to incorporate Troy Gaston's habitat fishery linkages study into the Draft Report for the CMP: *'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 (Gatson et al., 2019)'.* Add the following reference for above into the CMP: Gaston, T., Smith, T., and Raoult, V. (2019). Quantifying habitat-fishery linkages in Lake Illawarra, NSW. The University of Newcastle.	Yes, this information should be added to the CMP.	Insert wording in second last sentence of the first paragraph under section 2.2.5 of the Draft CMP, and update references accordingly.

Agency and Other Organisation Submissions

Organisation	Comment	Response	Proposed Changes
DPI Fisheries	Requested that DPI Fisheries continues to be kept informed of any changes to the draft CMP following the public exhibition and that DPI-Fisheries is included in the formation of any new actions that may directly relate to fishing, dredging or other impacts upon aquatic habitats.	Yes, this will occur.	None required.
EPA	Require a minor word change to Section 2.2.6 to reflect that unless there is evidence of current industrial land uses causing contamination of the Lake, they should not be implied to be doing so.	Yes, this change is accepted.	Change Section 2.2.6 from "Industrial land uses of the past and present have left a legacy of contamination…" to "Past industrial land uses have left a legacy of contamination…"
EPA	Noted that Section 3.3. identifies "A total of 41 actions were subject to a multi-criteria cost benefit analysis. From this, 36 actions were selected for implementation under the nine strategies". However, based on a count of actions provided in the tables in Section 4.1 to 4.9, 37 actions have been selected for the CMP; and Appendix E page E-26 Table E-2 (Multi-criteria cost benefit analysis of actions) is missing the assessment of action EC5, i.e. only 41 actions went through the MC CB analysis.	Some actions in the plan were selected/included in the CMP based upon community and stakeholder consultation outcomes, however it is an omission that EC5 was not put through the multi-criteria cost benefit analysis. The CMP draft needs to be updated to include that some actions were added due to community/stakeholder influence.	Add new section 3.4 to explain that some actions were selected / added based on consultation and qualitative information from stakeholders and community. All new actions will be run through the multi-criteria cost benefit analysis, including EC5.
EPA	Errors in the activities of Port Kembla Copper (PKC) were identified in Appendix E, with EPA providing the correct information to update the table.	Yes, this change is accepted.	Update Row 50 Column titled "Completion Status" to read "PKC's Detailed Site Investigation Report dated 13 February 2017 (Section 4.3) states that "*Southern Copper emplaced approximately 300,000 tonnes of granulated copper slag between 1992 and 1995, after which PKC emplaced a further 300,000 tonnes between 2000 and 2003*". Slag emplacement ceased in 2003 when the PKC smelter closed." Remove "sediment" from list of things monitored by PKC.

Agency and Other Organisation Submissions

Organisation	Comment	Response	Proposed Changes
EPA	Errors identified in Section 4.1 in Action WQ2 "Locations", that refers to "Nicole Road drain exiting Korrungulla Wetlands (former Port Kembla Copper site)". The WCC / Korrongulla wetlands are separate to PKC's site and are located to the west of the former PKC slag emplacement area. The current proposed future use of the former PKC slag emplacement area is for it to form part of the wetland reserve subject to WCC agreement.	Changes to rectify this error should be completed.	Update Action WQ2 in "Locations" column remove the statement "(former Port Kembla Copper site)". Update sentence about monitoring by WCC to read "Monitoring by WCC at Nicole Rd.… implemented by the LIA" and move this sentence to the "Further Information" column.
DPIE – Crown Lands	Provided updated naming convention for the department, and provided updated wording regarding lands to which DPIE – Crown Lands is responsible for under the *Crown Land Management Act 2016*, and with regards to foreshore lands that they own and manage.	Yes, this change is accepted.	Update CMP (and related documents) with correct naming convention and notation regarding lands for which DPIE – Crown Lands is responsible.
DPIE – Crown Lands	Provided minor wording changes and agreement to be responsible (along with other listed organisations) for CMP actions as a responsible or supporting organisation, in line with changes to actions provided.	Yes, this change is accepted.	Update CMP to reflect responsibilities (as responsible or supporting organisation) agreed to by DPIE – Crown Lands for specific actions.
NPWS	Identified changes to department names within the "Responsibility…" column for the Actions. Agreed to be responsible or supporting organisation for specific actions, as provided in comments.	Yes, this change is accepted.	Update department names for former OEH and NPWS to their new name and acronym in the "Responsibility…" columns for all CMP Actions, and to reflect responsibilities (as responsible or supporting organisation) agreed to by NPWS for specific actions.
LLS	LLS stated that, as resources allow, they are happy to be listed as a supporting organisation for the actions they've been identified for in the public exhibition draft CMP, including Action MF1.	Acceptance appreciated, and agree to add LLS as supporting for Action MF1.	Update Action MF1 to include LLS as a supporting organisation under the "Responsibility…" column.

Agency and Other Organisation Submissions

Organisation	Comment	Response	Proposed Changes
Property NSW	• In relation to Action WQ2, upgrades and maintenance to existing stormwater quality management measures would require consultation with Property NSW during any forward planning processes to identify the required level of engagement.; • In relation to Action WQ3, upgrades and maintenance to the existing stormwater network and wetland is a Council responsibility. Recent works have been undertaken to improve access for maintenance at the Kully Bay AFL oval location. • In relation to Action PM4, ongoing consultation with Property NSW would be undertaken in support of the Kully Bay north section of the Lake. Any action would be undertaken after prior consultation with Property NSW and should relate directly to the Estate Management policy and strategy across the Kully Bay site. • In relation to Action EV1, Property NSW requests input into any planned features on the wetland and foreshore prior to any decisions being made in this regard. Property NSW request consultation during any planning process for these works, and Property NSW will consider the proposed management action in the current review of the site. • In relation to Action IR2, Property NSW requests consultation during the planning process that includes any planning for features on the wetland or whole of Zone 8 Lake activity. Property NSW current infrastructure sufficiently caters for community and recreational use in the North West sector of Kully Bay (Zone 8).	The comments have been noted.	None required.
Property NSW	In relation to Action IR2, Property NSW requests better clarity on the responsibility for each item; and seek formal consultation during the development of the Program and that any actions assigned to Property NSW will be carried out within the limitations of normal operating and planning procedures.	Change to the action should be made to better reflect specific Property NSW responsibilities. Remaining comments are noted.	Update Action RA1 in "Responsibility…" column, next to Property NSW include the statement "in lands that they own and manage".
Property NSW	Any expectation of Property NSW will require consultation prior to any actions being assigned to Property NSW over the Kully Bay portion of the Lake.	Change to the action should be made to reflect consultation requirements	Update Action RA2 details to include the statement "Consultation will occur with all appropriate landowners in negotiating the preferred route".
Property NSW	Property NSW is in the process of upgrading Strategic Asset Management Plans for all assets within the Kully Bay locality. This action is considered current within our review of the site and will identify risk of future tidal inundation. Property NSW requests consultation if any future confirmation of Asset Management Plans is required.	Changes to include the upgrade to Strategic Asset Management Plans is required.	Update Action IR1 "Further Information" to note that "Property NSW is in the process of upgrading Strategic Asset Management Plans for all assets within the Kully Bay locality."

Agency and Other Organisation Submissions

Organisation	Comment	Response	Proposed Changes
Property NSW	CMP Section 4 notes that all relevant approvals, permits and licences must be obtained prior to enacting any CMP Action. Property NSW would like confirmation that enacting the actions will include notifying them of any proposed work programs that affect Property NSW owned assets or land, to enable organisation of access requirements to their land / assets.	Yes, minor wording change to reflect need for notification is accepted.	Update CMP section 4 to include "notifications" as required prior to actions.
Property NSW	In relation to Action WQ9, Property NSW request clarity regarding their responsibility to undertake site investigation works on Property NSW land, most notably, such as Lot 3 in DP 1154074 located between Kemblawarra Industrial Park and Griffins Bay, in the case where investigation work associated with WQ9 identifies contamination.	EPA have provided advice regarding these concerns that has been forwarded to PropertyNSW.	None required.
Sydney Water	Provided agreement to responsibility for actions (as responsible or supporting, as listed in CMP). Other minor changes to wording etc requested.	Yes, this change is accepted.	Update CMP to reflect minor wording changes.
Sydney Water	Sydney Water has acknowledged being a responsible organisation for Action WQ6 and Action IR1, and a supporting organisation for Action PM1.	Acknowledgement is appreciated.	None required.
Sydney Water	Requested to be included as a supporting organisation for Action PM4, as they seek to be engaged with the Asset Management Working Group.	Yes, this change is accepted.	Update Action PM4 to include Sydney water as a supporting organisation.
Sydney Water	Requested a minor wording change to Action WQ9 state that contaminated land reports can be shared under a 'Data Sharing Agreement'.	Yes, this change is accepted.	Update Action WQ9 "Further Information" to state "Contaminated land reports can be shared under a 'Data Sharing Agreement'."
Sydney Water	Business Plan funding arrangements for Action WQ6 in relation to Sydney Water do not appear related. Suggest removing reference to 'Special Infrastructure Contribution' in this context.	Yes, this change is accepted.	Update Business Plan details for Action WQ6 to remove the reference to the 'Special Infrastructure Contribution'.

Agency and Other Organisation Submissions

Organisation	Comment	Response	Proposed Changes
Sydney Water	Request clarification in the CMP regarding the CM SEPP and their responsibilities for undertaking environmental protection works and coastal protection works that they need to do from time to time to maintain their customer and environmental obligations. Under CM SEPP Clause 10 and Clause 19 (2a(i)), public authorities can only undertake environmental protection or coastal protection works without development consent where such works are identified in the relevant CMP. Otherwise, a development consent is required for such works. Outcomes of the clarification should be used to update the "Further Information" text for Action WQ6; and to determine if a separate section identifying works in the CMP that Sydney Water may carry out to maintain their customer and environmental obligations (i.e. works to repair, maintain, and to undertake minor modification to our assets and their immediate surrounds to enable efficient operation of our wastewater and water assets and mitigate their potential impact to the environment).	DPIE Policy Branch has provided advice regarding these concerns that has been forwarded to Sydney Water.	None required.
Energy Australia	Reiterated their support for the proposed "around the Lake" shared pathway (Action RA2) including from Macquarie Rivulet to Tallawarra Power Station and on to Haywards Bay, stating "the multiple benefits from the development of a shared pathway to local residents, visitors and tourists are fully endorsed by EnergyAustralia (EA)".	Endorsement is appreciated.	None required.
Energy Australia	Requested clarification to provide a clearer understanding of the purpose of monitoring to investigate potential pollution sources under Action WQ9, in particular, the purpose of identifying data gaps, developing monitoring programs and negotiations for remediation, and how this may relate to the ongoing sale of the northern and central parts of Tallawarra Lands; and then how Action WQ9 interacts with EnergyAustralia's current compliance with their environmental protection licence and the satisfaction of their land management obligations.	The PMT have requested EPA to respond to this clarification request from EnergyAustralia.	None required

Agency and Other Organisation Submissions

Organisation	Comment	Response	Proposed Changes
Energy Australia	Indicated that EnergyAustralia is required to undertake annual seagrass mapping as a part of their Environmental Protection Licence. Have sought understanding of how their compliance monitoring may interact with the mapping to occur under Action EV4. EnergyAustralia have also sought information more generally on how the Councils and EPA will manage estuarine vegetation migration (i.e. Action EV5).	In response to the requests for information, it is noted: • Action EV4 is not intended to replace or repudiate EnergyAustralia's mapping under its EPL requirements. It is intended to provide a picture over time of seagrass and other vegetation extents across the entire Lake. • Action EV5 relies on available retreat space on public land (which has already been identified) and is then voluntary with private land owners.	Update Action EV4 "Further information" column to add "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."
Energy Australia	EnergyAustralia respectfully rejects statements made in the CMP (Table D-1, Page D-4) regarding the impacts of thermal discharges, i.e. causing variable dissolved oxygen levels and loss of Zostera and other seagrass species and foraging habitats that then impacts upon marine wildlife. Energy Australia provided updated information that: • their (independently authored) annual seagrass monitoring reports have shown that Tallawarra Power Station is not having a significant effect on all seagrass species distribution or volume; • they continue to comply with their EPL, and water pollution from elevated temperatures and variable dissolved oxygen are also incorrect; and • the use of heated water to minimise bi-fouling of the powerstation system rather than chemicals is designed to reduce the impact to Lake Illawarra.	The response is duly noted, and changes should be made to relevant sections of the CMP to reflect the updated information provided by EnergyAustralia that is specific to Lake Illawarra.	Update Table D-1 "Thermal Discharges" row 2nd column to state "While these effects may have been measured elsewhere / in the past, ongoing and regular seagrass and other monitoring by EnergyAustralia in Lake Illawarra in accordance with their Environment Protection License (EPL) have shown that Tallawarra Power Station: • is not having a significant effect on all seagrass species distribution or volume; • continues to comply with its EPL requirements to ensure it is not causing water pollution from thermal discharges; and • the use of heated water to minimise bi-fouling of the powerstation system rather than chemicals is designed to reduce the impact to Lake Illawarra.

Agency and Other Organisation Submissions

Organisation	Comment	Response	Proposed Changes
Energy Australia	In relation to Action EV1, EnergyAustralia indicated its strong understanding of its responsibility for managing the Tallawarra Lands, including the management of Tallawarra Point and the riparian vegetation of Duck Creek. EnergyAustralia also stated their understanding the importance of healthy terrestrial vegetation and estuarine vegetation to the water quality in Lake Illawarra. They have requested clarification of the proposed rehabilitation plans in the context of their ongoing compliance obligations.	Indicative costing for EnergyAustralia to be reviewed.	Update EV1 to remove $500,000 allocation to EnergyAustralia lands.
National Parks Association (NPA)	Availability of the CMP: believe CMP should have been more widely distributed in print, even if only in black and white. The large format tables are too hard to read online.	Comments have been noted	None required
NPA	Have observed areas where illegal rubbish dumping has taken place on the foreshore and intertidal zone. This deserves an increased level of policing and clean-up to help improve the ecology and visual amenity of these places.	While there are a number of actions in the CMP relating to improving water quality, it is noted that a more specific response to litter is required.	*As per Issue 8: Litter -* Update Action PM3: • add to title "and implement". • add to details "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 (similar to the Rise and Shine Program)"; and • add to details regarding education program "e.g. relating to litter and plastics, illegal dumping". Update action PM1 details to include "continue to support / promote Council submissions to state government on key lake issues e.g. cockle collection, legislation around waffle pods, etc". An action has been drafted and is proposed to be included in the Water Quality strategy within the CMP, namely WQ8 – Improve litter management, supporting the councils to provide more bins and collections in summer, compliance programs to reduce illegal dumping and support clean up days/ rubbish removal twice a year in key locations.

Agency and Other Organisation Submissions

Organisation	Comment	Response	Proposed Changes
NPA	Noted the environmental impacts of over-lake raised pathways. If any more similar structures are proposed, NPW submit that the broader community should be consulted. NPA inspected the condition of the short walking track on Picnic Island and were satisfied with the track condition and the lack of visible rubbish on and around the island.	The comments are noted	None required.
NPA	NPA submit that Council should seek to resume or purchase a public right of way along the foreshore upon the properties with lots to the high water mark when they are being sold (e.g. Oak Flats), to allow public access to the foreshore and provide opportunity for Council to better manage the condition of the shoreline.	The comments are noted, and an action to this effect is already included in the CMP, refer Action RA3	None required.
NPA	While the NPA think the EV provisions for rehabilitating vegetation and controlling damage to it are laudable, they believe they could be strengthened such as by: • specifying the major weeds spread by water and their treatment; • providing recommended plant lists for parks and domestic gardens; • raising public awareness of the need to manage gardens in a lake-friendly way; • include species lists of significant native vegetation, birds and aquatic creatures in the CMP; and • manage weeds on Picnic Islands.	The comments are noted. CMP actions such as PM3 and EV3 will involve community engagement and education regarding Lake foreshore vegetation. Picnic and the other entrance islands are identified locations for rehabilitation (see Action EV1). Supporting documentation to the CMP as well as NSW Government websites already provide lists of vegetation and fauna species.	None required.
NPA	Recommend that the CMP include a provision for progressing Aboriginal involvement in planning and management of the Lake, e.g. that the councils provide assistance and/or advocate for greater resources for appropriate Aboriginal groups to be involved. It is NPA's view that the CMP is tentative regarding provisions for Aboriginal knowledge and involvement. The report makes a number of gestures towards indigenous people's relationship to the Lake, including setting up an Aboriginal Reference Group and planning to protect cultural heritage (indigenous and non-indigenous); however it is NPA's view that there are no specific provisions for protecting Aboriginal heritage or involving Aboriginal people in managing the Lake. NPA has the impression that the involvement of and input by the Illawarra Local Aboriginal Land Council has been significantly restrained by the process. NPA wish to see this rectified shortly so that Aboriginal people can be fully involved in planning and managing the Lake.	The comments are noted. It is further noted that the ILALC and the Aboriginal Reference Group has been involved. Further information needs to be provided to the NPA regarding the consultation process and consultation to date. Minor change to the CMP is required to note the involvement of councils' cultural heritage staff in the CMP process.	Update Table 2.1 of the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* Report (BMT, 2020) to include cultural heritage staff as involved in the CMP process.

Agency and Other Organisation Submissions

Organisation	Comment	Response	Proposed Changes
NPA	Request more recognition of the indigenous history of Picnic Island and the need to preserve it by way of informative signage at the bridge entry point to the island.	Comment noted, and change to CMP is recommended.	Update Action CH1 details to include "Encourage signage recognising the indigenous history of relevant sites" Update Action EV3 details to include "Cultural Heritage" and add ILALC as a supporting organisation
NPA	NPA submit that the Councils should have a strategy to declare marine conservation zones in the Lake. In line with Australia's commitments under the Convention on Biological Diversity, known as Aichi, for the protection of terrestrial and marine areas.	The comments are noted and shall be forwarded to DPI Fisheries as the appropriate manager of marine resources.	None required
NPA	NPA note the Lake Illawarra Entrance Channel Management Options Study includes correspondence with the EPA in relation to possible impacts of the use of sediment tracers containing plastic materials. They also note the risk assessment rating has been reported as low in the study. However, NPA are concerned that this issue of plastic contamination has not been fully explored and we submit a further review of the possible impacts be undertaken.	The comments have been noted.	None required
NPA	Shorebirds predominantly use the limited suitable space on the Windang side of the entrance. It is NPA's view that this habitat must be protected and expanded.	The comments are noted, and are already adequately managed through Action MF1 in the CMP.	None required.
NPA	NPA believes there are clear benefits for residents and users from the opening of the entrance in terms of consistent water flows and volume. However, it may also have led to unrealistic expectations by the community for example that the Lake should be permanently clean and deep enough to be usable for boating and that the smells from natural processes of vegetation breakdown can be eliminated. NPA venture to suggest that discontinuing with the open entrance may be a more practical and sustainable solution (than dredging) in the long term.	The comments are noted. Action EC1 will involve a detailed assessment of all available options for managing the entrance condition, which will include entrance closure.	None required.

Agency and Other Organisation Submissions

Organisation	Comment	Response	Proposed Changes
NPA	NPA notes that dredging is an expensive and impractical measure which would disturb toxic sediment, among other effects. To proceed with further dredging for aesthetic and recreational reasons would be impractical.	Concerns raised in public exhibition about the impacts of dredging have been taken into account in drafting the two new dredging actions (refer Section 1.4.1 for potential impacts).	*As per Issue 1: Dredging -* Two new actions have been drafted to be included in the Recreational Amenity strategy within the CMP (as RA5 and RA6). The new actions state clearly that any dredging undertaken must minimise/ avoid negative environmental impacts. The potential for impact and any mitigative / avoidance controls would be determined on a case by case basis as part of standard environmental approvals for any dredging episode.
NPA	Request clear recognition of the priority of the health of Lake Illawarra in the urban development plans. NPA are concerned that the West Dapto, Yallah and Calderwood plans do not include enough provision for maintaining local vegetation in the open space areas. For example, the tree listed in Councils Open Space plans for West Dapto contained many exotic species and did not include many local species which experts have recommended for use in urban plantings and bushcare sites.	The comments are noted, and will be forwarded to the Councils with regards to exotic species in Council open space plans. Action PM1 includes updates to the LEPs and DCPs with regards to improving biodiversity outcomes. Action WQ1 proposes a best practise risk based approach to managing urban runoff, by considering impacts on waterway health.	None required.
NPA	Submit that the Yallah Corridor (mentioned in the regional plan) and any other candidate corridors must be considered part of the Lake's ecology, to manage terrestrial, intertidal and marine environments in unison.	The comments are noted, noting also that the focus of the plan is the immediate foreshore / intertidal areas, restoration of riparian areas of tributaries that would improve water quality in the Lake, and catchment water quality.	None required.
NPA	With regards to the West Dapto development, NPA are concerned that Council needs to maintain a 'big picture' perspective when there are so many diverse aspects of an urban development to be managed. Improving the health of Lake Illawarra has to be a high priority in all of the following plans; Floodplain Risk Management Study and Plan, Water Cycle Management Study and Plan, updated Wollongong Local Environmental Plan, 2009, Wollongong Development Control Plan, 2009.	The comments are noted, and are already managed through Action PM1: the councils are required to consider CMP actions and objectives.	None required.

Agency and Other Organisation Submissions

Organisation	Comment	Response	Proposed Changes
NPA	NPA have noted that some tributary flood studies (Duck Creek, Mullet Creek) make little mention of the Lake in determining flood risk. It is NPA's understanding that some of the works completed in accordance with floodplain risk management plans such as detention basins have proven to be ineffective. NPA question that creeks that flow into Lake Illawarra carry greater flood and associated risk than those which flow directly to the ocean, and that such studies need better recognition of the connections between the creeks and the Lake which they feed.	The comments are noted. The Lake Illawarra Floodplain Risk Management Study is the most up-to-date document on flood risk in the Lake, and will have included contributions from the tributaries. With a permanently open entrance, Lake flooding will now be somewhat controlled by the ocean water level rather than fluvial inputs. Flood studies are required to consider the Lake water level as the downstream boundary.	None required
NPA	NPA particularly applaud the emphasis on managing water quality from urban developments, though these measures are unlikely to affect existing levels of sedimentation. The measures WQ1-10 are bold measures that if strictly enforced will prevent further deterioration and enable the ecology to improve. However, in light of recent exposure of the corrupt behaviour of some private certifiers and the use of dangerous building materials, the NPA note that the effectiveness of WQ1-10 will be dependent on the construction industry being more effectively regulated.	The comments are noted. Action WQ5 includes provision for better training for private certifiers and improved compliance resources for construction sites, which is intended to address concerns such as those raised in NPA's comments.	None required.
NPA	NPA note that the views of residents expressed in recent media discussion do not appear to take note of the scientific backing behind the CMP. NPA believe a strong community engagement program to improve public understanding is urgently needed, taking as a model other successful council community engagement plans such as the 'Grow Local' program of some years ago. NPA state that the suggestions in the CMP are well-intentioned but are rather vague and are not allocated much money. NPA suggest that the community education program should include more definitive details for school and community programs such as the production of elementary booklets illustrating key messages such as the vision for the Lake, why it should be appreciated and things that residents and visitors should do / be aware of, for example.	The comments are noted, and Actions PM3 and EV3 already include the suggested approaches provided here by NPA.	None required.

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Lake Illawarra Coastal Management Program (2020-2030)

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Wollongong City and Shellharbour City Councils have prepared this document with financial assistance from the NSW Government through its Estuary Management Program. This document does not necessarily represent the opinions of the NSW Government or the ~~Office of Environment and Heritage~~Department of Planning, Industry and Environment.

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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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DISTRIBUTION

Destination	Revision										
	0	1	2	3	4	5	6	7	8	9	10
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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)~~The preparation of this CMP was overseen by a project management team consisting of Kristy Blackburn, Jessica Faustini (WCC & SCC) Philomena Gangaiya (WCC), Tuesday Heather (SCC), and Danny Wiecek (OEH) and the Lake Illawarra Estuary Management Committee~~.

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.

Glossary of Terms

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
~~**Physiochemical**~~	~~Of or pertaining to both physiology and chemistry, or physiological 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.

Glossary of Terms

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 $43,300,000 over 10 years, plus an estimated $27,500,000 for long term entrance channel works following action EC1. Based upon the timeframes for actions and estimated costings, $4,693,000 is required in Year 1 to implement specified actions. A forecast $29,537,000 is estimated across Year 2 to 5 (inclusive), with a final $36,570,000 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 Community Strategic Plan.

Once the plan 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 ~~Office of Environment and Heritage (OEH)~~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 ~~Lake Illawarra CMP shall thereby achieve~~ 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 ~~gives effect to~~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 ~~this~~ 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~~Figure 1-1~~~~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~~Figure 1-1~~~~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) ~~the Office of Environment and Heritage (OEH)~~, and ~~Department of Industry – Lands and Water~~DPIE ~~(~~– Crown Lands~~) (herein referred to as "DOI – Crown Lands")~~. Most notably, ~~DOI~~ 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 ~~general~~ 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~~.~~ ~~That is~~, as shown in Figure 1-1~~Figure 1-1~~~~Figure 1-1~~. That is, the CMP focuses on ~~covers~~:

- ~~up to the upstream tidal limits of~~ the tributaries to the Lake (~~namely~~ including Macquarie Rivulet, Mullet, Brooks, Duck and Horsley Creeks and other smaller creeks) up to and immediately beyond their tidal limits;
- 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~~,~~ ~~and~~

While the study area has a focus on the tidal part of the Lake, the ~~considers the~~ influence of the wider catchment areas ~~of the Lake~~ insofar as activities that pose a high threat to the estuary system (see Figure 1-1~~Figure 1-1~~~~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.

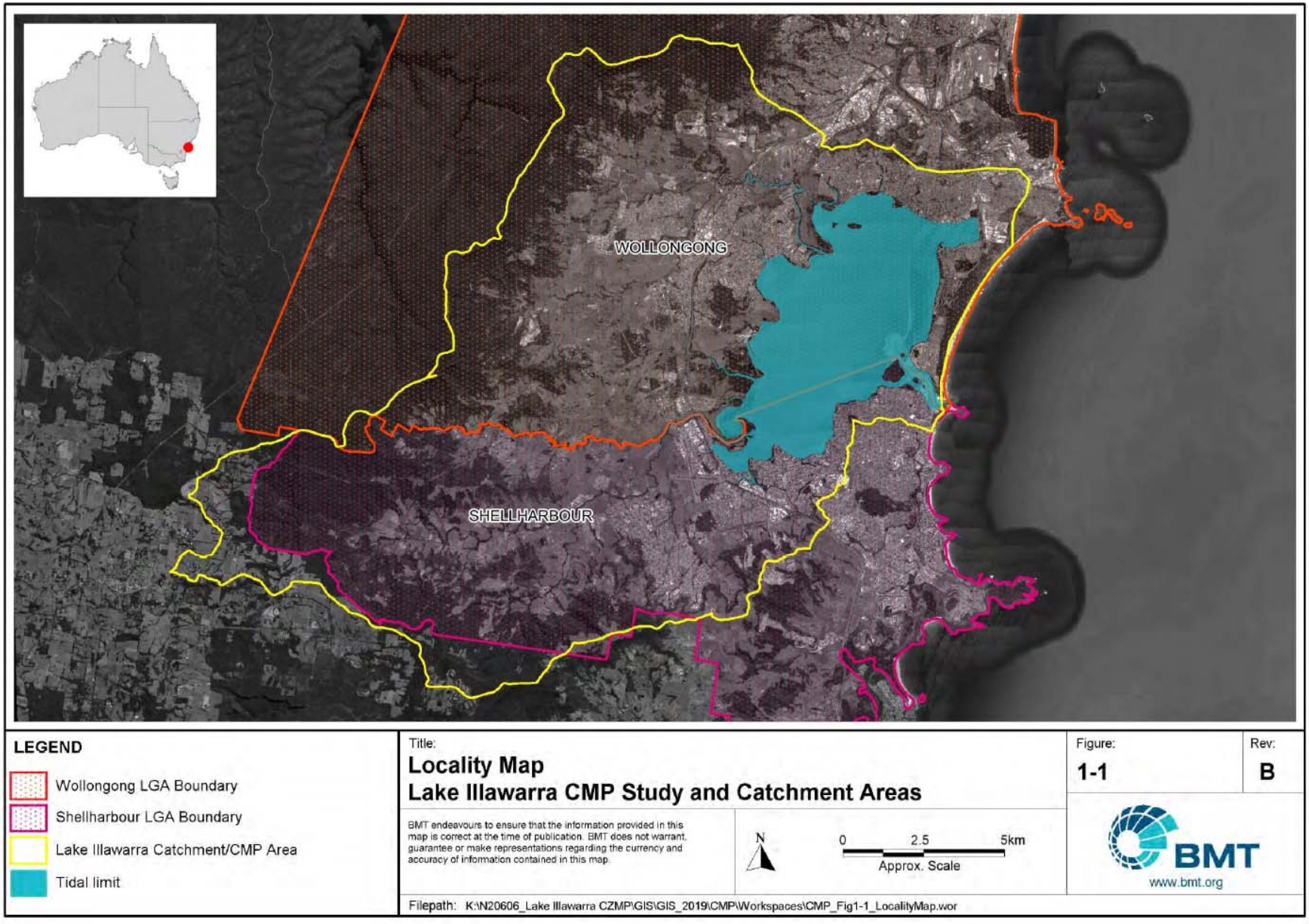
On behalf of WCC, SCC and DPIE, the University of Wollongong completed mapping of the tidal inundation hazard in Lake Illawarra that is projected to occur due to both the increasing tidal range in the Lake since permanent opening of the entrance, and sea level rise. Kumbier et al (2019) investigated 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 Options to Manage Erosion and Accretion Changes in the Entrance Channel and Implement Management Solutions	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

Action ID	Action Label / Descriptor	Coastal Hazard(s) Addressed
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


WOLLONGONG
SHELLHARBOUR
LEGEND
Wollongong LGA Boundary
Shellharbour LGA Boundary
Lake Illawarra Catchment/CMP Area
Tidal limit
Title:
Locality Map
Lake Illawarra CMP Study and Catchment Areas
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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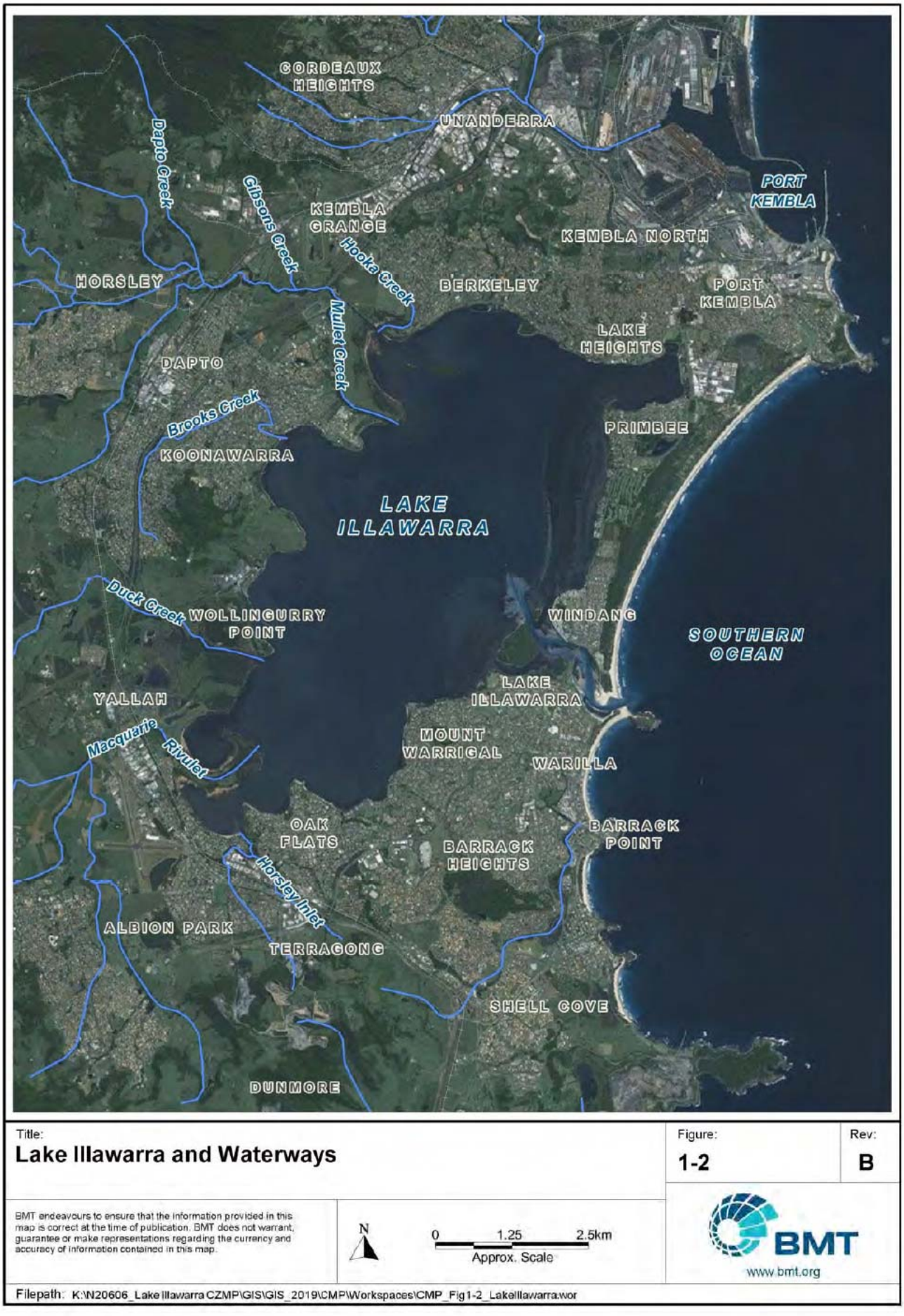

Title:
Lake Illawarra and Waterways

Figure: **1-2**

Rev: **B**

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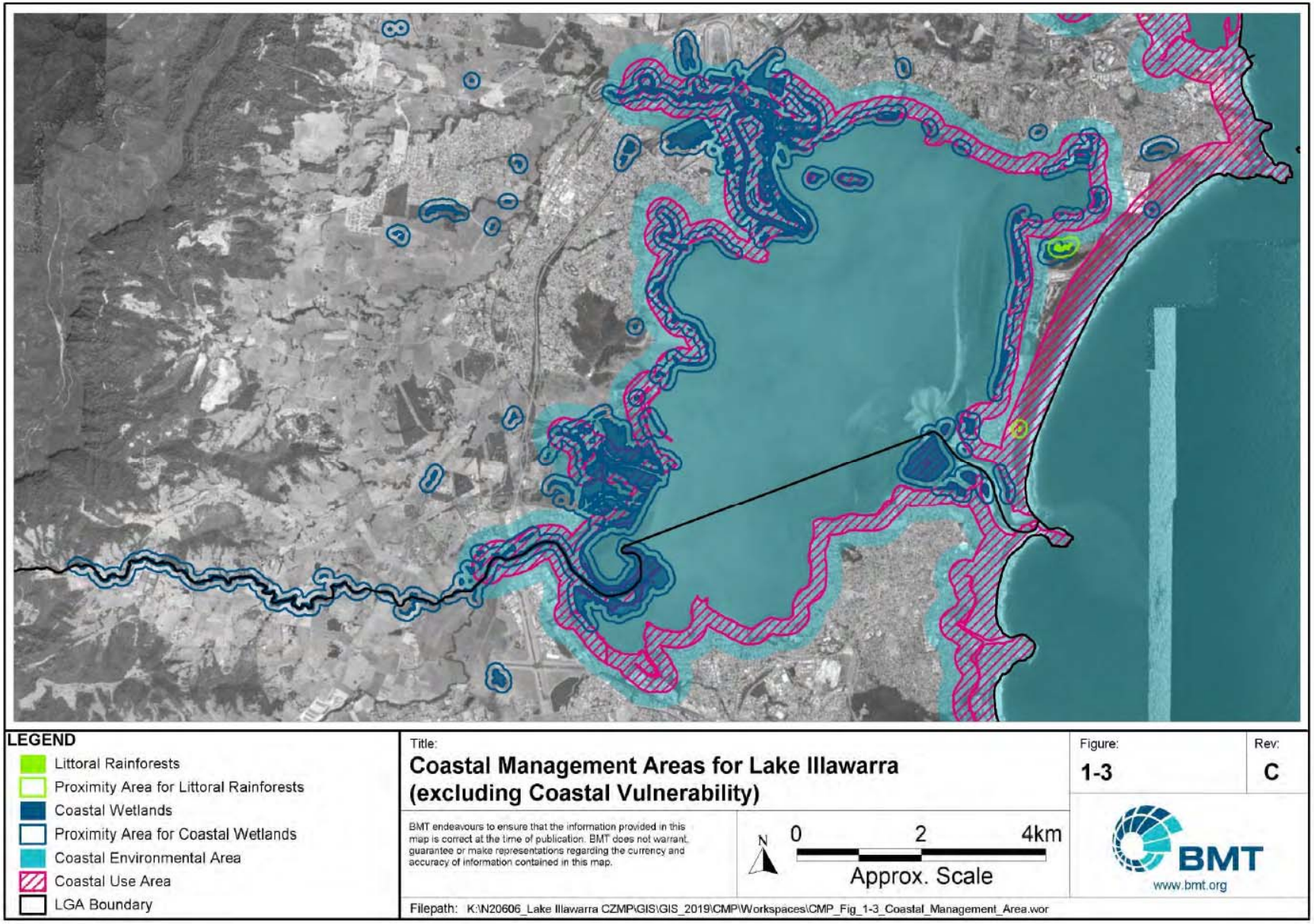
LEGEND
Littoral Rainforests
Proximity Area for Littoral Rainforests
Coastal Wetlands
Proximity Area for Coastal Wetlands
Coastal Environmental Area
Coastal Use Area
LGA Boundary
Title:
Coastal Management Areas for Lake Illawarra
(excluding Coastal Vulnerability)
BMT endeavours to ensure that the information 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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1.4 Who is the CMP for?

While the estuary and its catchment extend over ~~are partitioned into~~ 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 ~~OEH~~DPIE - Coasts & Estuaries, and this CMP aims to provide the judicious management of the Lake and its surrounds into the future.

DPIE - Coasts & Estuaries ~~OEH~~ 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 ~~Management~~ Program.

DP~~O~~IE – 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~~who, on behalf of the Ministerial Corporation, manage the Lake waterbody, land on foreshore and some associated infrastructure, are responsible 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), ~~the~~ DPIE Regions, Industry, Agriculture and Resources – Fisheries ~~NSW Department of Primary Industries Fisheries~~ (DPI Fisheries), DPIE – Planning and Assessment (DPIE – PA)~~Department of Planning and Environment (DPE)~~, Transport for NSW (TfNSW)~~Roads and Maritime Services (RMS)~~, ~~NSW~~ 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 ~~general~~ broader public.

1.4.1 Land Tenure and Ownership

~~Prior to~~Between 1988 and ~~July~~ 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). ~~Figure 1-3 provides information on which public lands and assets each Agency is responsible for.~~ 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. ~~This CMP has considered the obligations under the Native Title Act 1993 and Aboriginal Land Rights Act 1983 and proposed management actions will be undertaken accordingly. The entire CMP study area is included in the Native Title Claim (NC2017/003 South Coast People, registered 31/1/2018). No determinations regarding this Claim have been made to date.~~

~~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 which commenced 1 July 2018.~~

~~Figure 1-3 Management responsibility of Public lands and assets~~

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 location where they have been incorporated in this report are outlined in Table 1-2.

Table 1-2 Objects of the CM Act and their Consideration within this Report

CM Act Part 1	Objects of the CM Act	Action section in this CMP
Section 3a	to protect and enhance natural coastal processes and coastal environmental values including natural character, scenic value, biological diversity and ecosystem integrity and resilience.	4
Section 3b	to support the social and cultural values of the coastal zone and maintain public access, amenity, use and safety.	4.2, 4.5
Section 3c	to acknowledge Aboriginal peoples' spiritual, social, customary and economic use of the coastal zone.	4.6
Section 3d	to recognise the coastal zone as a vital economic zone and to support sustainable coastal economies.	4
Section 3e	to facilitate ecologically sustainable development in the coastal zone and promote sustainable land use planning decision-making.	4.2, 4.8
Section 3f	to mitigate current and future risks from coastal hazards, taking into account the effects of climate change.	4.3, 4.7, 4.8
Section 3g	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
Section 3h	to promote integrated and co-ordinated coastal planning, management and reporting.	4
Section 3i	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
Section 3j	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
Section 3k	to support public participation in coastal management and planning and greater public awareness, education and understanding of coastal processes and management actions.	4
Section 3l	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
Section 3m	to support the objects of the *Marine Estate Management Act 2014*.	4

1.5.2 Coastal Management Areas in the CMP Area

This Lake Illawarra CMP encompasses all four coastal management areas defined in the CM Act. Mapping of the coastal wetlands and littoral rainforest area; coastal environment area and coastal use area has been completed by DPE (2017) as reproduced in Figure 1-3. 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.

1.5.2.1 Coastal Vulnerability Area

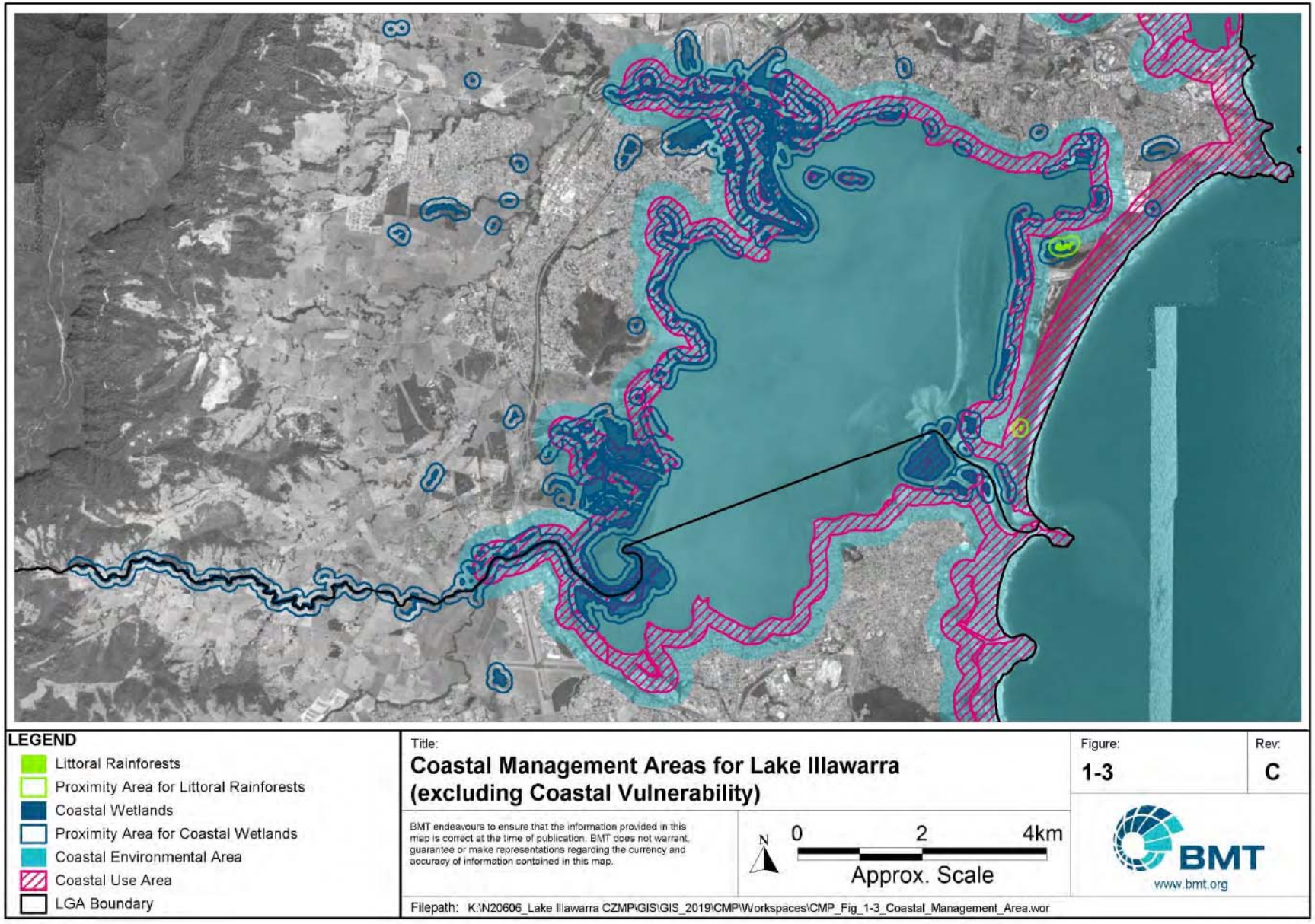
While DPE (2017) does not currently provide mapping of the coastal vulnerability area in NSW including for Lake Illawarra, it is recognised that Lake Illawarra is subject to coastal hazards and that the scope of this CMP also covers managing coastal vulnerability. Lake Illawarra is subject to coastal hazards including foreshore erosion, inundation due to catchment rainfall and/or elevated ocean water levels, 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, Tthe University of Wollongong has 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, 2019a). 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, 2019b).~~


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)
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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1.6 Timeframes Covered by this CMP

This CMP has been prepared for a 10-year period from 202~~0~~19 to 203~~0~~29. 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 ~~local~~ council's ~~local government area~~LGA contains land identified within the coastal vulnerability area, and if beach erosion, coastal inundation or cliff instability is occurring on that land~~, include a coastal zone emergency action subplan~~.

This CMP contains the above mandatory requirements, and has also been prepared in accordance with the Coastal Management Manual ~~available from~~ (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 ~~OEH~~ 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 Legislation

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, 2020~~19~~a) ~~which is contained in Appendix B~~.

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

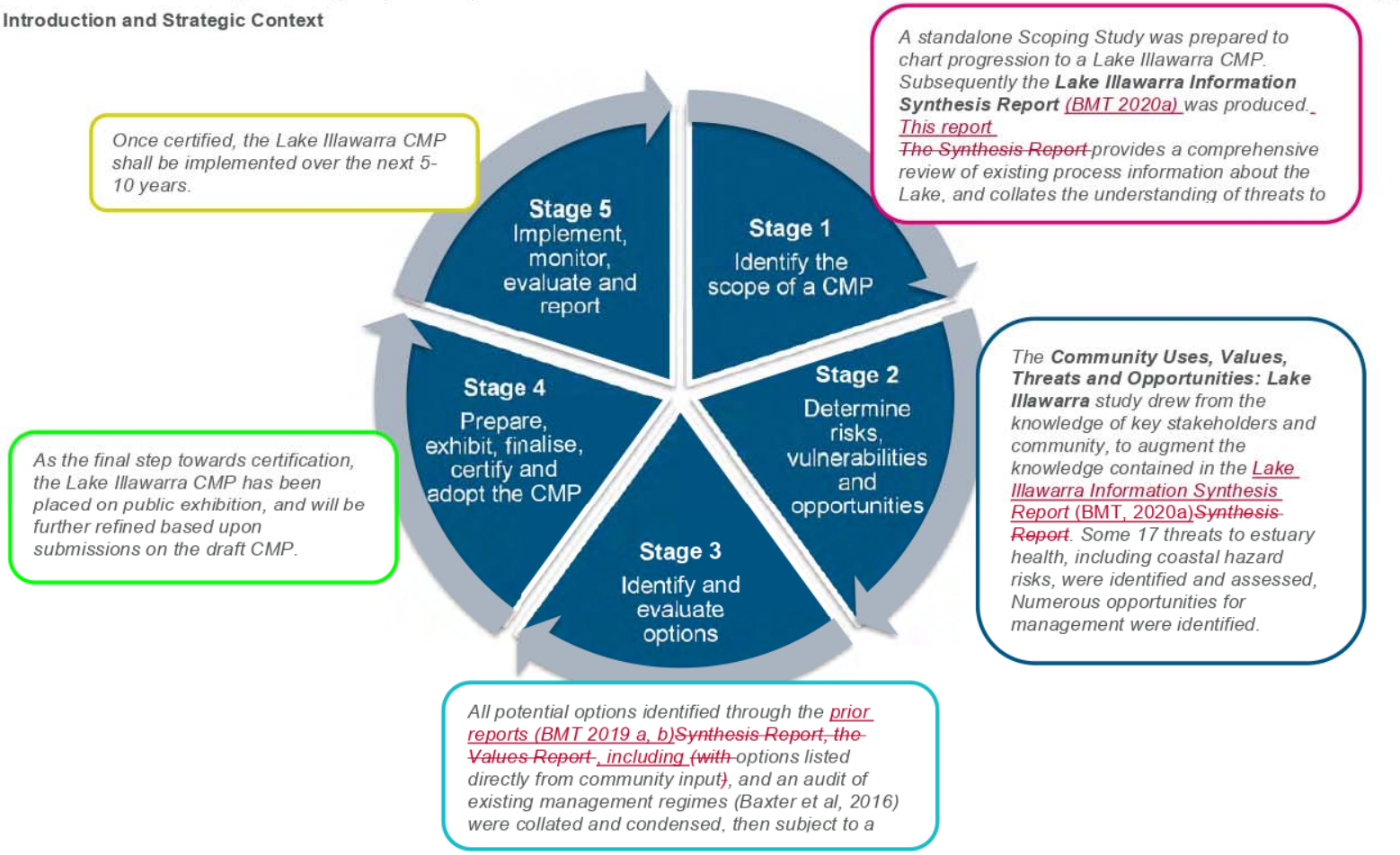

Figure 1-5 Alignment between the 5 Stage Process for CMPs and Lake Illawarra CMP and companion documents

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 ~~0~~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) ~~Synthesis Report~~ and the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b)~~Values Report~~.

1.7.3 Coastal Zone Emergency Action Sub-Plan

Currently there is no mapping of the coastal vulnerability area in NSW under the CM SEPP, including for Lake Illawarra.

Regardless, and A~~a~~s 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 adequately 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)

The above existing processes are considered to satisfy the requirement in the CM Act for an emergency action sub-plan to manage coastal vulnerability in Lake Illawarra (i.e. inundation risks arising from catchment rainfall and/or elevated ocean levels during storms). It is considered repetitious and potentially confusing to prepare a second set of emergency actions for coastal inundation risks through this CMP process.

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.

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).

~~Clause 12 of the CM SEPP only applies to coastal vulnerability areas where mapping for that area has been gazetted under the SEPP. Regardless,~~ 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 ~~of the CM SEPP applies to all land within the coastal zone, and~~ 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 suitableis already part of existing council development assessment processes. The existing coastal hazard 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 therefore 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* ~~(the Synthesis Report)~~ (BMT, 202019a) which collates and reviews a wide range of data, reports, plans and policies from over the past decade or more~~, and is reproduced in Appendix B~~. 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 ~~(the Values Report)~~ (BMT, 202019b) 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 ~~the Values~~ this Rreport which identified the threats listed with accompanying risk rating~~. The Values Report is provided in Appendix C~~.

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)~~Values Report, Appendix C~~. 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	• ~~Office of Environment and Heritage~~DPIE - Coasts & Estuaries • ~~Roads and Maritime Services~~TfNSW • DPIE Regions, Industry, Agriculture and Resources – South Coast Local Land Services (LLS)~~Local Lands Services~~ • DP~~O~~IE – Crown Lands • DPI Fisheries • Sydney Water • Endeavour Energy • Energy Australia • University of Wollongong

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Category	Stakeholders
	• ~~Department of Planning~~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 • 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)~~Values Report (see Appendix C)~~, 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 ~~w~~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~~Values Report, Appendix C~~) 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.

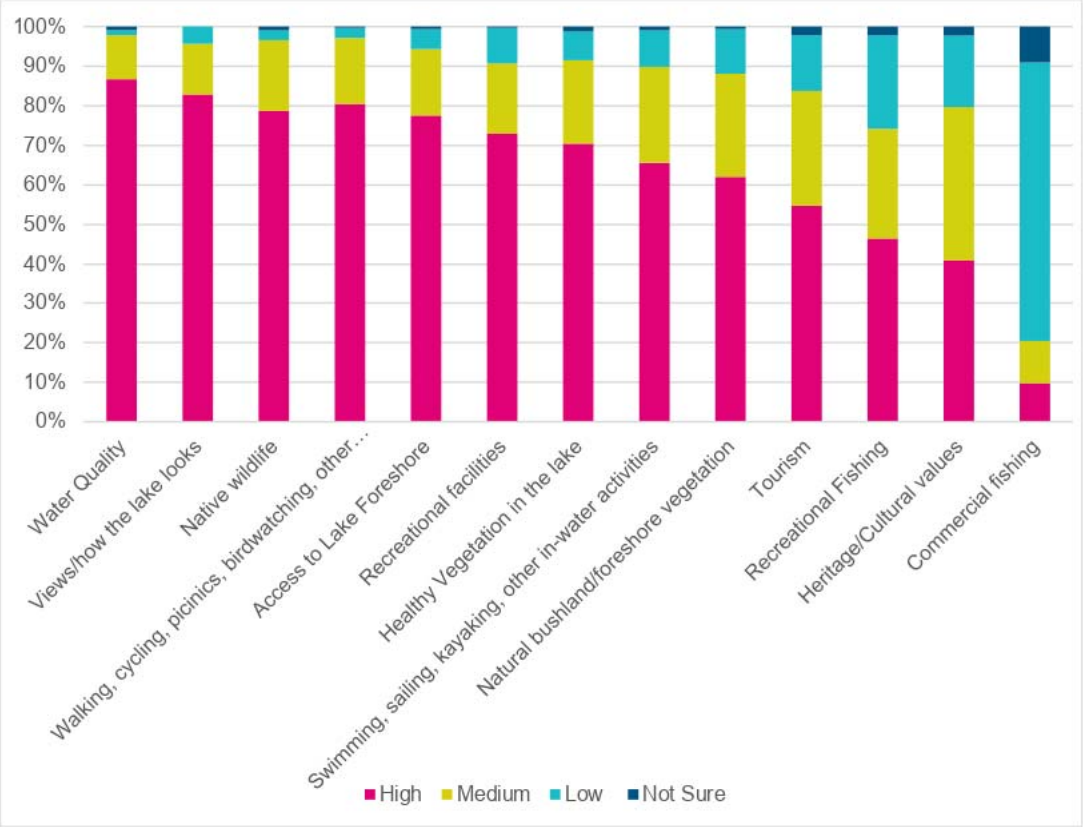


Figure 1-6 Community and Stakeholder Perception of Values Associated with the Lake

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)~~Synthesis Report~~ and the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b)~~Values Report~~ 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)~~Synthesis Report~~.

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 ~~(such as the Lake's frequently closed entrance condition)~~ 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, D~~O~~PIE –– Crown Lands, and Property NSW.

Foreshore land around the Lake is variously under the ownership and management of WCC, SCC, D~~O~~PIE – 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, 202~~0~~19a).

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 ~~since been replaced~~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~~, sections of footpath, lighting and other park infrastructure~~. 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 ~~near to the southwest of the main tidal channel, westward of~~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. ~~and entrance breakouts (which occurred prior to the permanent entrance opening).~~ 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~~provides habitat for fringing~~ 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

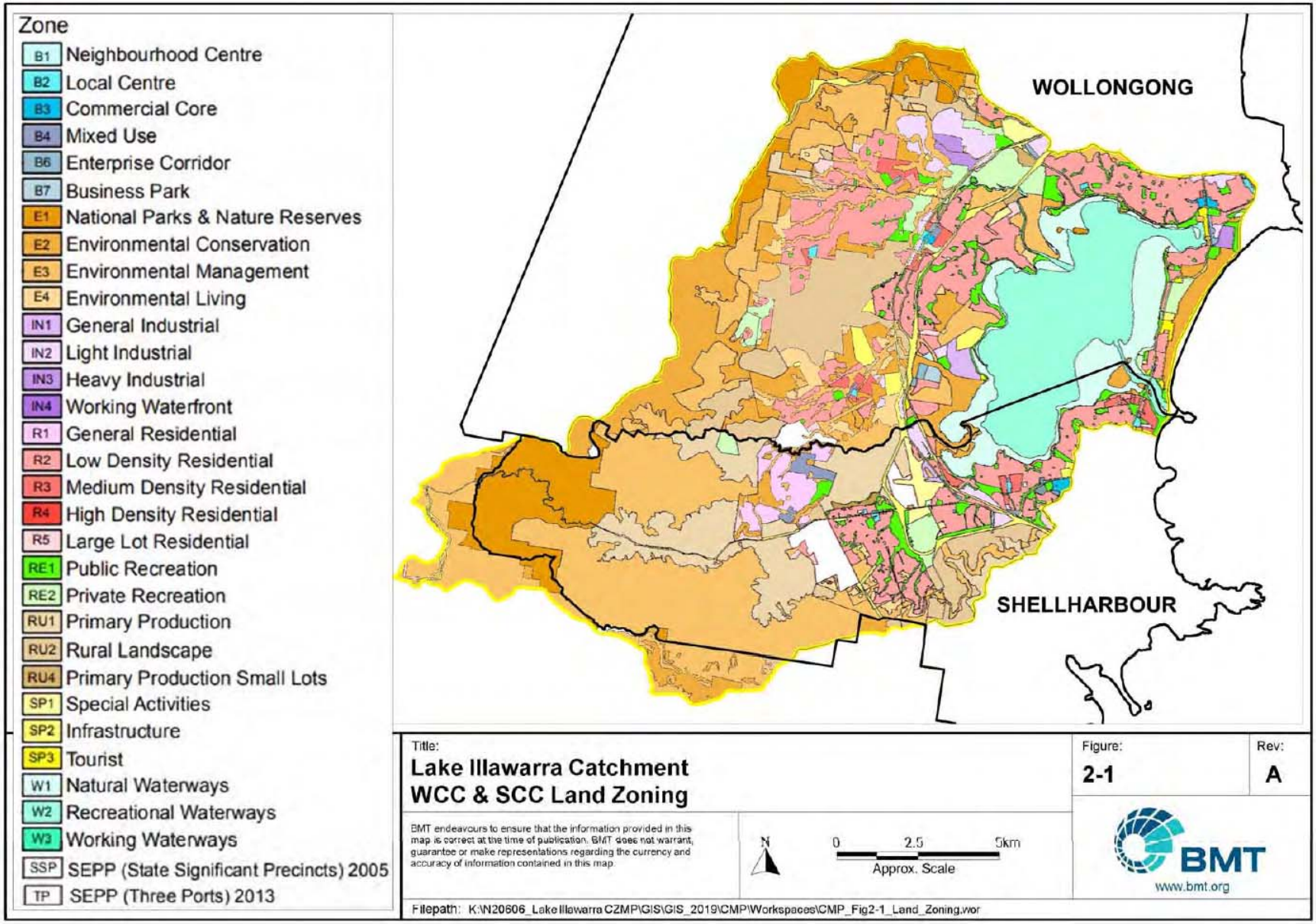
Today the catchment is about 60% cleared land, including urban, industrial and rural land uses, see Figure 2-1. The urban population in both Wollongong and Shellharbour has and is continuing to grow.

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.

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 ~~I~~industrial land uses ~~of the past and present~~ have left a legacy of contamination, which through groundwater and surface water runoff can transport contaminated water and sediments into the Lake.


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
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Lake Illawarra Catchment
WCC & SCC Land Zoning
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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)~~Values Report~~ 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)~~Synthesis Report (BMT, 2019a) in Appendix B~~.

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), ~~as~~ and which was detailed in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b)~~Values Report (see Appendix C)~~. 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)~~Synthesis Report~~ and *Community Uses, Values, Threats and Opportunities: Lake Illawarra study* (BMT, 2020b)~~Values Report~~ 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. Conversely, other mechanisms of the Councils and State Government exist to develop and promote tourism opportunities, and are therefore not replicated by this CMP.

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 supports 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%
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'	40%

Value	Key points	Highly Valued*
	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.	
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 the Values Report (see Appendix C for full report).*

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. ~~Risk~~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 (D~~O~~PIE — 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~~OEH~~ 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)~~Synthesis Report~~ and *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b)~~Values Report~~, a list of threats to the condition and values of Lake Illawarra were identified. Refer to Section 5 of ~~the Synthesis Report (~~BMT (~~,~~202019~~a~~) for further details on threats. The threats were then assessed through a ~~risk~~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 ~~of away~~ (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 ~~risk~~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 ~~risk~~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 ~~risk~~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	~~Risk~~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 ~~risk~~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 ~~risk~~threat over the medium to long term if adequate management action is not taken.

Threat	RiskThreat Rating			Brief Description
	Present Day	Future: 2040-2050	Future: 2070-2100+	
Changes due to EEntrance Channel oOpening	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 continued 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, and continues to threaten 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 riskthreats 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	RiskThreat 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 ~~risk~~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 ~~risk~~threat to human health. Where sediments remain undisturbed and continue to be overlain by new, clean sediments, the ~~risk~~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 ~~risk~~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 ~~risk~~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 ~~risk~~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	RiskThreat 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 ~~risk~~threats of foreshore development encroaching on public lands, as foreshore lands are reduced and as residents attempt to mitigate unstoppable inundation impacts. Therefore, the ~~risk~~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 ~~risk~~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 ~~risk~~threat rating for this threat is expected to increase to High across the next 20, 50 and 100 years.

Threat	~~Risk~~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~~mostly certainly~~ 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 ~~risk~~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 ~~risk~~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 ~~risk~~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 ~~risk~~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.

Threat	RiskThreat Rating			Brief Description
	Present Day	Future: 2040-2050	Future: 2070-2100+	
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 ~~risk~~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 ~~risk~~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)~~Appendix E (Strategies Assessment)~~. ~~Development of the management strategies was also drawn from the community consultation and scientific evaluation as detailed in the Synthesis Report (Appendix B) and Values Report (Appendix C).~~

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)~~Synthesis Report~~, and from community and agency input listed in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b)~~Values Report~~.

To implement each broad management strategy, a subset of specific management actions was developed using ~~a~~ the pool of potential actions identified as outlined above~~ through various means~~. 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.

~~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 Synthesis Report, and from community and agency input listed in the Values Report.~~

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)~~Appendix C Table C-1~~ 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. ~~From this~~, 36 actions were initially selected for implementation ~~under the nine strategies, with implementation details provided in Chapter 4~~.

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. ~~Based upon this assessment, 36 actions were selected for implementation across the nine strategies. Subsequent to this assessment, an additional action was added taking the total number of actions for implementation to 37. Implementation details for the 37 actions are provided in Chapter 4~~.

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 ~~risk~~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 the *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 C-2 of Appendix C~~.

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)~~Table C-2 of Appendix C~~).

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 C-2 of Appendix C~~.

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 ~~determine which~~enable selection of actions to implement through this CMP. The aim of ~~setting~~ the~~se~~ thresholds was to sensibly combine the threat mitigation and cost benefit analysis score~~s~~, 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)~~Table C-2, Appendix C~~. Based upon the total multi criteria (threat mitigation and cost benefit) assessment, 36 actions resulted. ~~However an additional action, EC5, was later added, to make the total number of actions for implementation 37, across the nine strategies.~~ Implementation details for the selected strategies and actions are provided in Chapter 4.

3.4 ~~Additional Actions Added~~ 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.

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 actions (EC1 is now focused on long term management, and EC3 now expanded to cover emergency works and incorporating dredging from former action EC3).

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).

The current 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)*	Responsibility, Supporting Organisations	Time-frame *(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~~OEH~~, 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~~OEH~~ – already funded)	~~OEH~~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. WCC and SCC DCPs are updated by the end of year ~~one~~ 1 to reflect the RBF reduction targets.	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)~~the Synthesis Report (BMT, 2019a)~~. 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,	WCC and SCC Supporting: ~~OEH~~DPIE	Year 1-2		

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
	• 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	WQ2, WQ3 and WQ4, to assist with implementation and managing consultancies (i.e. = $25,000 to this action)~~Staff time~~ ~~Staff time~~	WCC and SCC Supporting: ~~OEH~~DPIE	Year 1-3	Report on number of DAs submitted with two treatment trains. WCC and SCC make a decision re how to best implement the RBF by the end of year 3. DCPs updated accordingly where required.	
	• Outcomes of the ~~OEH~~ 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		

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)~~Synthesis Report (BMT, 2019a)~~. • 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,	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 ~~(former Port Kembla Copper site). Monitoring by WCC has not identified elevated metals in groundwater at end of Nicole Road. Stormwater treatment devices were designed, but not implemented by the LIA.~~ 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 ~~OEH~~, 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). ~~OEH~~ 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)*	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
	where appropriate and without compounding the risk of flooding.						

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
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.	

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
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.

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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
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)Additional staff resources required for both Councils: $160,000 p.a. initially for 2 years, ($80,000 each).	WCC, SCC. Supporting: DPIE - Coasts & Estuaries OEH, 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 withDevelop a collaborative relationship between the 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%Increase in # of incidents that are 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)*	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~~Figure 7-1~~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~~Figure 7-1~~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 Report* (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)*	Responsibility, Supporting Organisations	Time- frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
WQ7	**Implement existing water quality monitoring program for estuary health**, that measures: • temperature; • salinity; • pH; • dissolved oxygen, • turbidity; • total, dissolved and reactive forms of nitrogen and phosphorus; and • chlorophyll *a* 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 monitoring at 11 sites (see Section 7.4, Figure 7-1Figure 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 Refer to potential contamination sites, Figure 2-27 in Synthesis Report (BMT, 2019a).	$50,000 / year plus staff costs (time) of $4,000 / year	WCC on behalf of WCC and SCC Supporting: OEH	Year 1 to Year 5, then reviewed	Annual summary reports completed, displaying monthly monitoring data and analysis of results. Fiver year review undertaken.	Refer to Section 7.4 for detailed information on the monitoring program. 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 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
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.	
WQ8	**Undertake water quality monitoring for Recreational Use** 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.	Monitoring of 4 sites (BW1, BW2, BW3 and ELL see Section 7.4 Figure 7-1Figure 7-1), typically over the summer period.	$10,000 / year plus staff costs (time) of $4,000/ year	WCC on behalf of WCC and SCC.	Year 1 to Year 5, then reviewed	Beachwatch data is collected and available to the public during summer, and as needed.	Refer to Section 7.4 for other details.

WQ~~9~~9	**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). ~~There may be other potential contamination sources and sites (refer Synthesis Study (BMT, 2019a)).~~	$60,000 ~~per annum~~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 ~~supplied to~~shared with WCC and SCC ~~under a~~ 'Data Sharing Agreement' ~~upon request (with signed data licence 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".

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
WQ10	**Undertake water quality monitoring of physico-chemical and bacteriological indicators in the Lake catchment.** Review existing programs. Develop a revised program to address the following issues: • Localised pollution incidents that trigger further investigation; • Pre- and post- development indicators; • Link to management actions; and • Link to WQ1. • Add additional monitoring locations to account for future development (e.g. Yallah Bay)	Catchment wide.	$60, 000 / year plus staff time	WCC SCCand, WCCSCC Supporting: OEH	Year 1 then ongoing	Program is developed. Annual summary reports completed.	Refer WQ1
	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.	L.	$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 per year.	WCC and SCC Supporting: EES / 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.	

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

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

Strategy Implementation Plan

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

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 ~~outcomes of~~ WQ1; – Coastal hazard management including long term inundation risks (on public and private lands), using relevant controls e.g. ~~,~~ foreshore setbacks etc; – ~~, and/or other relevant planning controls, for long term inundation risks (public and private lands), and~~ the Environmentally Friendly Seawall Guidelines. • ~~Update or produce new POMs for community or crown land to include relevant CMP actions / objectives.~~ • Revise LEPs Cconsidering CMP management areas and objectives ~~when revising the LEP~~. • ~~Review and u~~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 ~~RMS~~ 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, D~~O~~PIE – Crown Lands, ~~OEHDPIE – -~~ Coasts & Estuaries, ~~TfNSWRMS~~, Sydney Water.	Year 2: DCP and LEP updates Remaining as required ~~to 10~~	• Windang Town Centre Plan has been revised to reflect appropriate CMP actions and objectives • 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	WCC has allocated $25,000 to developing the Windang Town Centre Plan Refer also to the Illawarra-Shoalhaven Regional Plan WCC are working on a new Land Dedication Principles Policy, Shell Harbour are considering a similar one.

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
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~~LIEMC~~ and foster collaboration with agency stakeholders and recognise Stakeholder Reference Group~~LIEMC~~ 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~~LIEMC~~. • 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~~LIEMC~~ 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.

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; s~~S~~chool holiday programs • Programs targeting specific interest groups e.g. Aboriginal Community, Bushcare, fishers. • ~~Formation of~~ or support for existing ~~local environmental groups or support current~~ community groups to ~~provide engagement and~~ participate ~~inion and~~ / or undertake activities such as water quality monitoring, ~~, or~~ estuarine vegetation rehabilitation~~,~~, passive compliance (e.g. using local residents to monitor and report ~~on~~ 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	Sites previously identified as potential locations for signage include: Hooker Park and Reddall Reserve Foreshore Area of Davies Bay Koona Bay and 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)~~OEH~~, ILALC, DPI Fisheries,~~NPWS~~	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
	• Formation and maintenance of a website that outlines the environmental management of Lake Illawarra. • Annual review of community programs and processes.						

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 ~~Boating~~ 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; • ~~Oversee and coordinate management of the entrance channel and associated channel migration issues~~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~~Figure 5-2Figure 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: D~~O~~PIE – Crown Lands, ~~and~~ 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: D~~d~~evelop ~~Boating~~ 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.

~~4.2~~4.3 Manage the Entrance Channel (EC)

Strategy Implementation Plan

Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost * (subject to available funding resources))	Responsibility, Supporting Organisations	Time-frame *(subject to available funding and resources)	Performance Measure	Further Information / References

https://thegong-my.sharepoint.com/personal/ltalevski_wollongong_nsw_gov_au/Documents/Desktop/CMP with Track Changes - test.docxY:\N20606_Lake Illawarra CZMP\Docs\2020_Drafts\R.N20606.003.08.CMP_TrackChanges_100320.docxK:\N20606_Lake Illawarra CZMP\Docs\2020_Drafts\R.N20606.003.08.CMP_TrackChanges_100320.docx

EC1	**Investigate Options to Manage Erosion and Accretion Changes in the Entrance Channel and Implement Management Solutions~~Investigate Options to Manage Erosion and Accretion Changes in the Entrance Channel and Implement Management Solutions~~** 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, and implement preferred management options taking into account any built, environmental and cultural heritage issues. 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. This working group will need to include both councils, tfNSW, DPIE - Coasts & Estuaries DPIE – Crown Lands, DPI Fisheries.~~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, and implement preferred management options taking into account any built, environmental and cultural~~	**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 (drop over) entering the Lake waterbody Some sections of the southern foreshore of the Lake (e.g. swimming areas of Reddall Reserve)~~**Investigation Area:** Entrance Channel (and adjacent coastal or lake zones as required to inform study). The entrance channel is defined as the area between~~	Lake entrance management options study: ($460,000, already programmed by WCC). Detailed design, assessment and approvals of preferred management option/s requiring more immediate response e.g. Windang foreshore protection: ~~-~~ $2500,000K. Detailed design, assessment, and approvals for possible preferred long-term management option to constrain flow and limit ongoing tidal increases (including cost benefit analysis): $1.00~~-~~5M. Implement actions to address foreshore erosion, channel scour and accretion: ~~-~~ $5~~-~~102~~-~~5M. Implement longer term action to constrain flow and control tidal increases: $150~~-~~250M.~~Lake entrance processes and management options study: ($460,000, already~~	WCC, SCC, DPIE – Crown Lands, DPIE – Coasts & Estuaries, TfNSW Supporting: ~~DPIE – EES, RMS, DPI Fisheries~~WCC, ~~SCC, DOI – Crown Lands~~ Supporting: ~~OEH~~EES, ~~DOI – Crown Lands, DPI Fisheries~~	Year 1: ~~-~~ Finalise management options study Year 1-3: Prepare detailed design, assessment and approvals for more immediate actions Year 1-5: ~~-~~ Implement more immediate actions to manage erosion/accretion Year 1-3: Longer term management option study, design and assessment Year 5-10: Implement preferred longer term option to manage ongoing tidal velocity/prism increase~~Year 1-2: Conduct investigation~~	~~•~~ Study of issues and potential management responses for the entrance channel is completed ~~•~~ Preferred actions are implemented ~~•~~ Preferred actions are monitored as being effective and environmentally sensitive~~Study of issues and potential management responses for the entrance channel is completed.~~ • Preferred actions are implemented. • Preferred actions are monitored as being effective and environmentally sensitive.	Emergency management and other works are currently occurring and/or will be required for someto 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 EC23). Should anythe preferred action involve dredging of marine sand, and the sand not be required for remediating erosion elsewhere in the channel, ~~that~~ 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.~~Should the preferred action~~

	heritage issues. This study shall investigate the hydrodynamics, sediment transport, erosion and sedimentation patterns occurring in the channel, and develop management options to address any built, environmental and cultural heritage issues, using a cost benefit analysis to assess options. The preferred solution(s) shall then be implemented. 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. 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 or groynes; or strategic retreat other options e.g. retreat (e.g. erosion on island foreshore where no assets) or limiting 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 support the completion of the management options study and assessment and design of preferred management options including a possible longer term management option to constrain channel flow. This working group will	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: • northern shore of the entrance channel between along Windang Foreshore Park and Windang Beach Tourist Park • northern point of Reddall Reserve • northern shore of Picnic Island • Bevans Island, Berageree Island, swimming lagoon wall, southern training wall and the Windang Bridge. Areas in the channel known to be experiencing sedimentation (deposition / accretion): • Flood tide delta (drop over) entering the Lake waterbody • Some sections of the southern foreshore of the Lake (e.g. swimming areas of Reddall Reserve)	programmedin progress). Stage 2 detailed options investigation and design (including cost benefit analysis): $0.5 – $1M. Implement actions to address foreshore erosion, channel scour and accretion - $2-5M; longer term actions to control tidal velocity / prism / range increase: $10-20M.		Year 3-4: Conduct Options Assessment Year 5-10: Implement preferred options		involve dredging of marine sand, and the sand not be required for remediating erosion elsewhere in the channel, that 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 ~~resources~~))	Responsibility, Supporting Organisations	Time-frame ~~*(subject to available funding and resources)~~	Performance Measure	Further Information / References
	~~need to include both councils, RMS, DPIE (coast and estuaries) DPIE (Crown Lands), DPI Fisheries. These methods have different environmental and long-term impacts, and may affect the ability to implement other methods in future (e.g. permanent structures are difficult to change once implemented). This must be considered when selecting an erosion control approach. The potential impact on cultural heritage sites from erosion and / or the management action selected must also be considered. Erosion control methods need to optimise environmental outcomes as well as being technically, economically and socially feasible. Changes to the entrance channel affect the entire lake water quality and ecology.~~ *Note: emergency management and other works ~~may~~that are ~~be~~ required ~~for some assets,~~ to ~~manage~~ensure public infrastructure~~safety~~ 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.*						

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 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 knowledge these actions can and should be progressed. Further detailed investigation through EC1 is not required to determine the need for the action. Example actions include: • placing rocks below Windang Bridge piers for stability; • Park); Endeavour Energy; temporary works to protect power poles on Picnic Island;	• East of Windang Bridge along northern foreshore (e.g. either side of groynes). • Picnic Island (power poles) • Windang Bridge piers, foreshore	Revetments ~$10,000 / m; Rock placement $??	WCC, RMS (Windang Bridge), Crown Lands (e.g. sections of northern foreshore); Endeavour Energy (power poles on Picnic Island) Supporting: DPIE – Environment, NPWS	Year 1-2	Emergency works / small scale mitigative works are completed in a timely manner in keeping with environmental principlesa	
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.	WCC, SCC Supporting: DPOIE –Crown Lands, TfNSWRMS, DPIE - Coasts & EstuariesOEH, DPI Fisheries	As required	Access and amenity is restored to swimming and other waterway amenity areas.	Needs to be consistent with EC1 Options study from EC1 to reflect 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
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 replacing failed protection with rock revetments east of Windang Bridge, northern side (i.e. at Tourist Park); • Endeavour Energy temporary works to protect power poles on Picnic Island; and ~~**Undertake dredging in the entrance channel, as required to maintain navigation**~~ • ~~Undertake~~ Ddredging ~~(if / as when~~ needed~~)~~ to manage sedimentation and improve navigability e.g. flood tide delta. If dredging is undertaken:~~, and provided dredging is consistent with the preferred solution derived in Action EC1.~~ – Reuse dredged marine sand to remediation foreshore erosion / ~~on~~ nearby beaches (e.g. Warilla, Perkins~~);Beach) and suitable lake foreshores.~~ ~~Monitor the success of the dredging in terms of longevity of navigation, effectiveness /longevity of nourished beaches, adverse / positive impacts on surfing breaks / sand bars, and beach amenity.~~ 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.~~secondary tidal channel opposite Reddall Reserve~~ • ~~Flood tide delta~~	$10 M to replace failed revetments on northern foreshore east of bridge (based on past WCC expenditure). $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).~~ $2 million (per event, estimate based on dredging conducted in 2007)~~	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~~WCC, SCC, DOI – Crown Lands~~ ~~Supporting: RMS, OEH, DPI Fisheries~~	Year 1- 5, or as required prior to commencement of actions from EC1.~~As required~~	Emergency works / small scale mitigative works are completed in a timely manner in keeping with environmental principles. ~~The~~Any dredging campaigns ha~~s~~ve had positive outcomes for navigation and for beach nourishment	Links to EC1 and EC4. ~~Needs to be consistent with Action EC1.~~ 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~~1~~-5~~2~~ 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 (such as completed through EC1). 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)~~Drone surveys ~$10,000 to establish, then $5,000 per repeat.~~	WCC, SCC Supporting: DPIE - Coasts & Estuaries ~~OEH~~, DP~~O~~IE – 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, ~~OEH~~ DPIE can ~~commission~~ 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 ~~and if required, upgrade~~ existing entrance channel infrastructure, with any works to be informed by EC1~~-~~, EC23 and EC4.** Infrastructure includes but is not limited to: • training works • breakwaters • groynes • revetments.	Entrance Channel	$150,000 - $240,000 pa	DP~~O~~IE – Crown Lands, Endeavour Energy, ~~RMS~~TfNSW, WCC, SCC, Supporting: DPI Fisheries and ~~OEH~~DPIE - Coasts & Estuaries.	Ongoing	Ensure entrance infrastructure is fit for purpose, structurally sound and safe for use.	Note Action EC1 shall guide any major upgrades to infrastructure, which may be required to ameliorate erosion / accretion impacts etc.

~~4.~~34.4 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)~~-~~ ~~($500,000)~~; 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, DP~~O~~IE ~~–~~ Crown Lands Supporting: NPWS, DPIE - Coasts & Estuaries ~~OEH~~, DPI Fisheries, ~~NPWS,~~ 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.
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,	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.	Depending on physical barrier selected, cost may range from $10,000 to $100,000. Additional staff resources for	WCC, SCC, DPI Fisheries. Supporting: DPI Fisheries, DPOIE – Crown Lands, OEH, NPWS, DPIE - Coasts & Estuaries, TfNSWRMS, LLS.	Year 1 and ongoing	• Number of hectares of vegetation managed (on private and public land) and number of illegal	See also the Purry Burry Point to Heritage Park Site Restoration Plan (2013), Berkeley Nature Reserve POM, Picnic Island Reserve POM;

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
	• tree damage and removal, • pedestrians, • illegal structures (e.g. land reclamation, seawalls, boat ramps (formal or informal), 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 or other impediment to replace vegetation removed. • 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.	• 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.	compliance $80,000 p.a. (shared across both councils).			activities investigated.	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, ~~and;~~ • 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. • Ffield days, brochures, ~~and / or~~ 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: ~~OEH~~DPIE- Coasts & Estuaries, CVA, LLS, DPI Fisheries, TfNSW, ILALC ~~and NPWS~~.	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)*	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**Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.**Appendix F) 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 in , Section 7.4)	$10,000 for area specific macrophyte monitoring (Year 2-5). $5025,000 per mapping episode (Year1, Year 6 and Year 10)., $10,000 for area specific macrophyte monitoring. $10,000 for area specific macrophyte monitoring (Year 2-5).	WCC, SCC Supporting: DPIE - Coasts & Estuaries OEH, DPI Fisheries, Energy Australia	Year 1: mapping Year 2 to 4: monitoring Year 6: mapping Year 10: mappingYear 1 and ongoing	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). MEMA may also be involved with this action. 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)*	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 , and in Figure 7-2 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 whichit 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)mapping in , and , in Section 7.4.7).	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 OEH, 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.

4.44.5 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 ~~available~~ 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 ~~Transport NSW and the RMS~~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 DPOIE – Crown Lands planning documents for future budget consideration. 6. Upgrades, maintenance and new infrastructure should be designed to be: • environmentally and fish friendly; and	**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)~~ ~~Reddall Reserve Foreshore Renewal ($250,000)~~ • ~~Skiway Park renewal of carpark etc ($1,000,000)~~ • ~~Renew Deakin Reserve carpark and facilities (estimated $250,000)~~ • • Lake Cycleway renewal: Lake Heights to Berkeley Boat Harbour ($120,000) • Primbee to Windang: Shared path renewal along Windang Road ($100,000) • ~~Windang foreshore repairs to boardwalk, retaining structures and boat ramp ($500,000)~~ Future work locations are to be determined by the audit (2) and Lake Illawarra Waterways Facilities Plan~~Boating 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+2.22 million. Independent audit / condition assessments: $60,000 ($20,000 to DPOIE – Crown Lands and $40,000 to WCC/SCC). Lake Illawarra Waterway Facilities Plan: $50,000. Future upgrades and costs ~~determined through the audit are estimated at a total of $740,000 per year based on current programmed works, to be confirmed through the~~ will be determined after the audit is completed~~course of this action~~.	WCC, SCC, DPOIE – Crown Lands, Property NSW (in lands that they own and manage) Supporting: TfNSW~~RMS~~, 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 ~~Boating~~ 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 ~~The action also links with~~ IR1 "Update Asset Management Plans to identify tidal inundation risk timeframes for asset". T~~ransport~~ fNSW may also need to

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
	• Wheelchair / disability accessible.						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: DPOIE – Crown Lands, RMSTfNSW, 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: DPOIE – Crown Lands, DPIE - Coasts & Estuaries OEH	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.

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
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. Conduct dredging within bays, creek entrances to the Lake, at boat ramps, jetties, wharves etc, on an opportunistic basis. As and when funding becomes available and there is a need to improve recreational access to the waterway (e.g. prior to a boating event, for wakeboarding, etc) conduct small scale dredging at discrete locations, such as a boat ramps, bays, creek entrances etc. Appropriate environmental approvals and controls must be in place prior to dredging to reduce the risks from dredging, which may include the re-mobilisation of contaminated sediments: and the loss of seagrasses, saltmarsh or other important aquatic vegetation and habitats.	Whole of lake?? NB – Locations and costings from 2013 Draft, that are in RA5 from Table E: Griffins Bay ($2.3M – 3M) Southern Back Channel ($1.9M – 3M) Karoo Bay ($0.75M – 1M) Koona Bay ($4.5M - 6M) Haywards Bay ($0.75M – 1M) Koonawarra Bay (inc Mullet Creek) ($0.75M – 1M) Purrah Bay ($1.1M – 1.5M) Koong Burry Bay ($5.6M – 7.5M) Tuggerah Bay ($15,000 – 20,000)	Staff time ???? per episode. NB – Costing for Business Plan might be based on 2 episodes over the 10 year period??	WCC, SCC Supporting: Destination Wollongong, Tourism Shellharbour, WCC, SCC, DPIE – Crown Lands Supporting: DPIE – Environment, RMS, DPI Fisheries	When the Destination Management Plans for Wollongong and Shellharbour are updated. Opportunistic as funding and need becomes available	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. Small scale dredging undertaken with appropriate environmental controls to improve recreational use and access to the waterway.	Destination Management Plan - Wollongong Destination Management Plan- Shellharbour 2018 – 2022LIA report on dredging conducted in Deakin Reserve??

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
RA5RAX	**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. 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.	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.Whole of Lake	$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, Environment, TfNSW, DPI FisheriesWCC and SCC Supporting: Destination Wollongong, Tourism Shellharbour.	Opportunistic, as funding becomes available and as need becomes apparent.When the Destination Management Plans for Wollongong and Shellharbour are updated.	Small scale dredging undertaken with all required environmental controls and approvals to improve recreational use and/ or functionality with minimal environmental impact. That the revised Destination Management Plans for Wollongong and Shellharbour are linked to the CMP. That 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.	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. Destination Management Plan - Wollongong Destination Management Plan - Shellharbour 2018 – 2022.

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 what type of environmental assessment will be required and likelihood of approval. 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. • A cost-benefit analysis which includes full lifecycle management considerations.	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 a Business Case, Environmental Assessment and Cost Benefit Analysis	If the investigations showed larger scale dredging was appropriate and viable the anticipated costs per episode would likely be $1M-$5M.

~~4.5~~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, ~~OEH,~~ ILALC, LLS, ~~NPWS~~.	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.

~~4.6~~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 ~~D~~POI~~E~~ – 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.*	$~~6~~70,000 for consultancy for bank condition assessment (allocation of $~~1~~5,000 to D~~P~~O~~I~~E – 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 ~~OEH~~, D~~P~~O~~I~~E – Crown Lands ~~& Water~~, 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 21. # 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. ThisLocations 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, DPOIE – Crown Lands, other land owners / managers Supporting: DPIE - Coasts & Estuaries OEH, 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 OEH	Year 5	A whole of lake and tributary bathymetric survey has been completed and analysed against historical data	

~~4.7~~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)~~Values Report~~).	Staff time (or $10,000 per agency / council for minor consultancy) to update asset management plans.	WCC, SCC, DP~~O~~IE – Crown Lands, Property NSW, Sydney Water, ~~TfNSW~~~~RMS~~, ~~NPWS~~DPIE - Coasts & Estuaries Supporting: ~~OEH,~~ DPI Fisheries	Year 2-4	All agency asset management plans are updated	The extent and risks from tidal inundation are ~~contained~~ in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b)~~Values Report (Appendix C)~~ 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. ~~Cost-benefit assessments should be factored into any management strategies~~ Property NSW is in the process of upgrading Strategic Asset

Strategy Implementation Plan

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
							Management Plans for all assets within the Kully Bay locality.

Strategy Implementation Plan

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, ~~DOI – Crown Lands~~ and Property NSW. Supporting: DPIE – Crown Lands, ~~OEH~~DPIE - Coasts & Estuaries, DPI Fisheries, ~~TfNSW~~RMS, ~~NPWS~~	Year5 -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)~~Values Report (Appendix C)~~ 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~~, for example as~~ 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 ~~/ or~~ other appropriate controls. Staff time to implement.	WCC and SCC Supporting: DPIE – PA, DPIE - Coasts & Estuaries ~~OEH~~	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~~, and~~; • 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~~OEH~~	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)~~Values Report (Appendix C)~~ 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~~OEH~~, 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.	

4.84.9 Protect and Manage Key Fauna (MF)

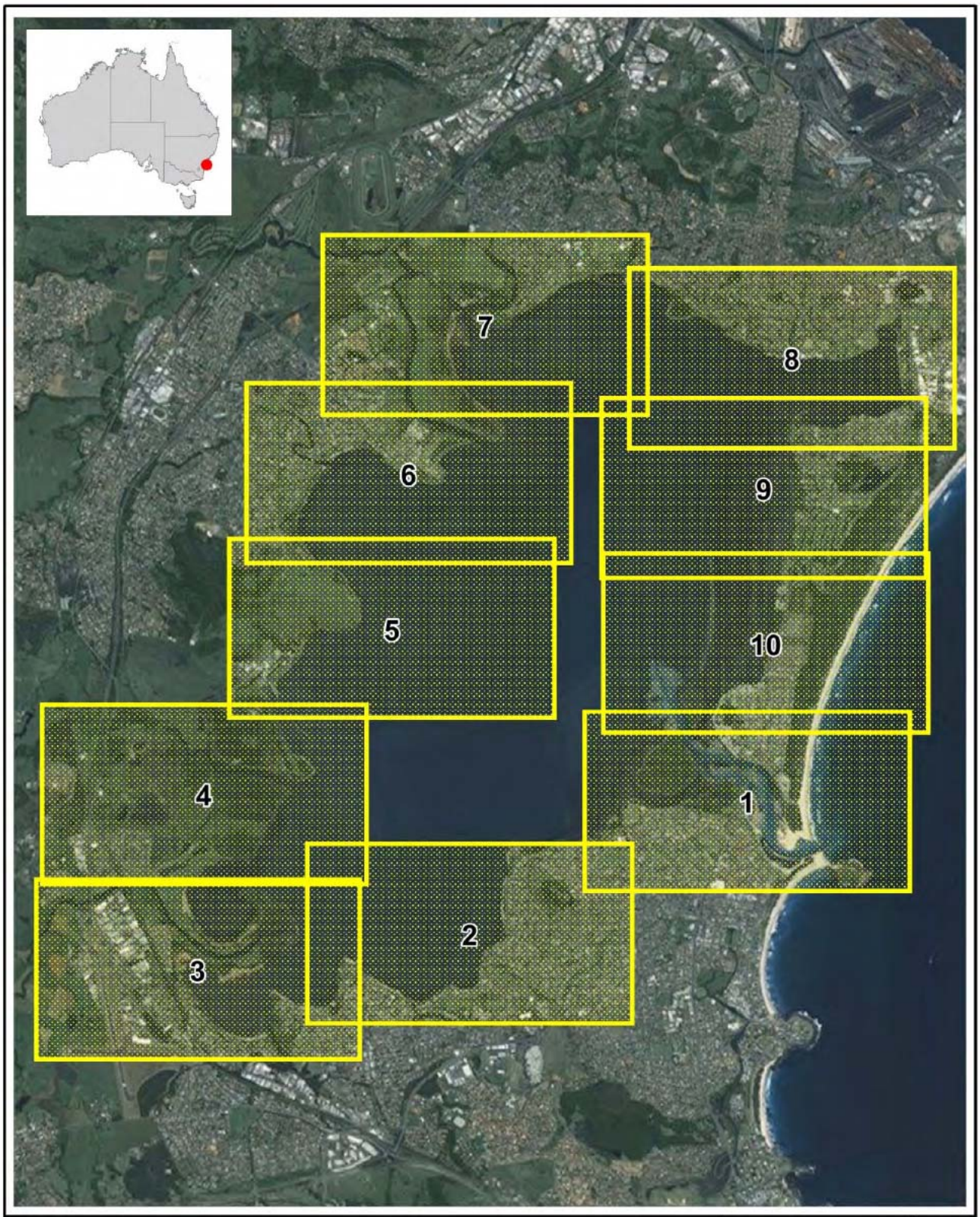
Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations / Programs	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
MF1	**Develop and implement a fauna 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)~~Synthesis Report (BMT, 2019a)~~) and assist DPIE – - Coasts & Estuaries ~~OEH~~/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, ~~OEH, NPWS~~, LLS, DPI Fisheries, TfNSW~~RMS~~, 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**

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.

N

0 1.25 2.5km

Approx. Scale

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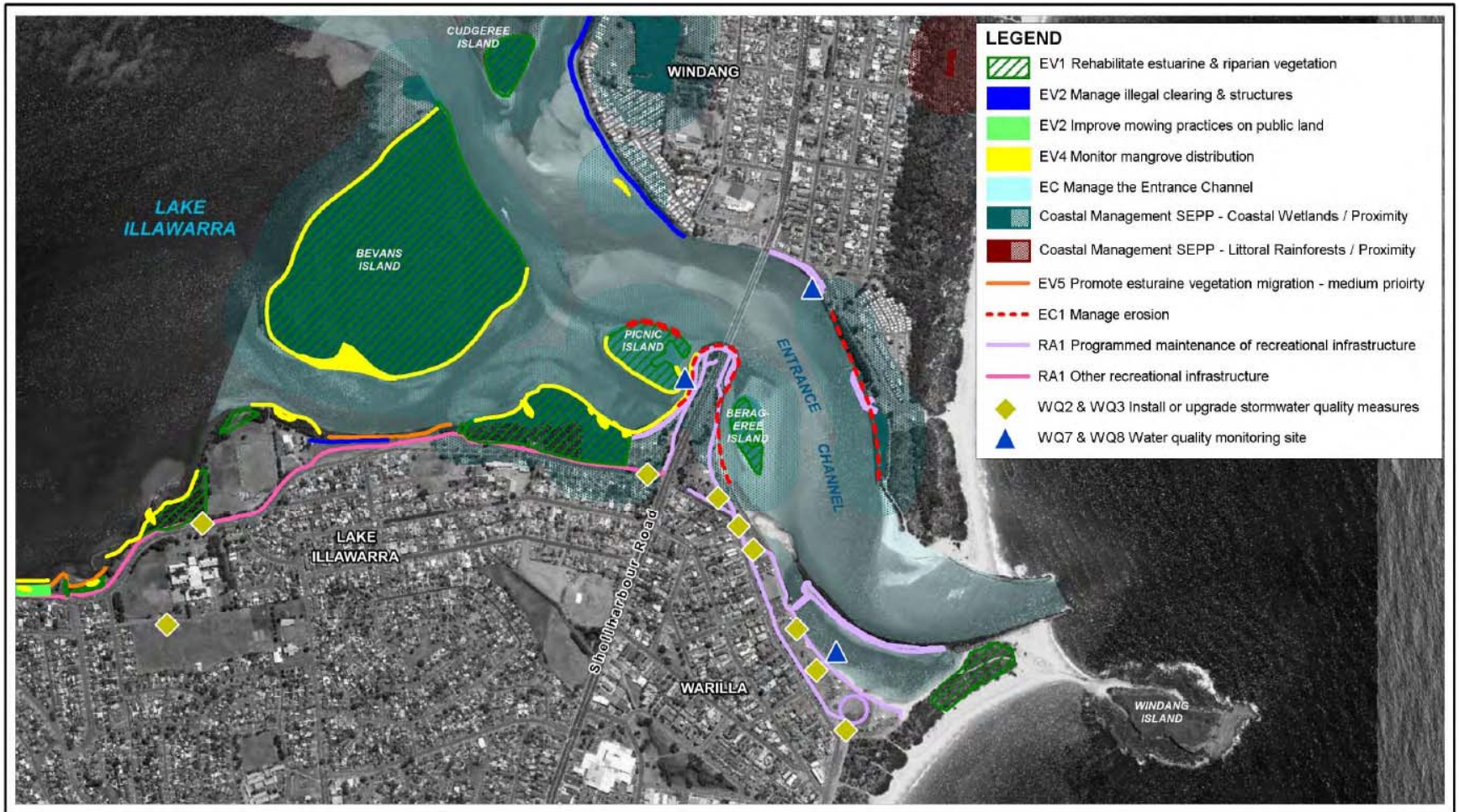
Filepath: K:\N20606_Lake Illawarra CZMP\GIS\GIS_2019\Figures



Title:
Lake Illawarra Management Actions - Zone 1

Figure: **5-2**

Rev: **C**

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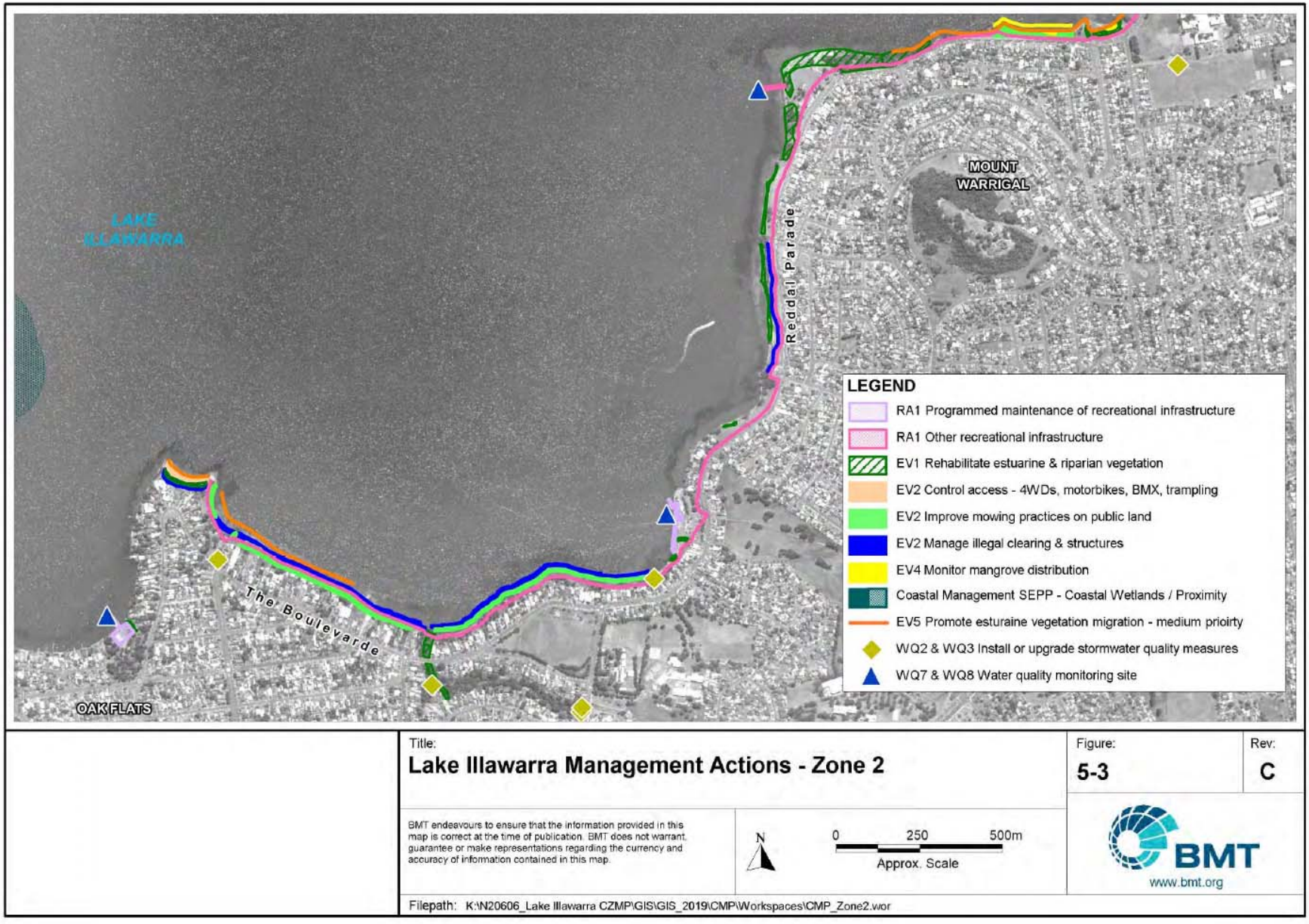
N

0 250 500m

Approx. Scale

BMT
www.bmt.org

Filepath: K:\N20606_Lake Illawarra CZMP\GIS\GIS_2019\CMP\Workspaces\CMP_Zone1.wor


LAKE ILLAWARRA
MOUNT WARRIGAL
Reddall Parade
The Boulevarde
OAK FLATS
LEGEND
RA1 Programmed maintenance of recreational infrastructure
RA1 Other recreational infrastructure
EV1 Rehabilitate estuarine & riparian vegetation
EV2 Control access - 4WDs, motorbikes, BMX, trampling
EV2 Improve mowing practices on public land
EV2 Manage illegal clearing & structures
EV4 Monitor mangrove distribution
Coastal Management SEPP - Coastal Wetlands / Proximity
EV5 Promote esturaine vegetation migration - medium priority
WQ2 & WQ3 Install or upgrade stormwater quality measures
WQ7 & WQ8 Water quality monitoring site
Title:
Lake Illawarra Management Actions - Zone 2
Figure:
5-3
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.
N
0
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Approx. Scale
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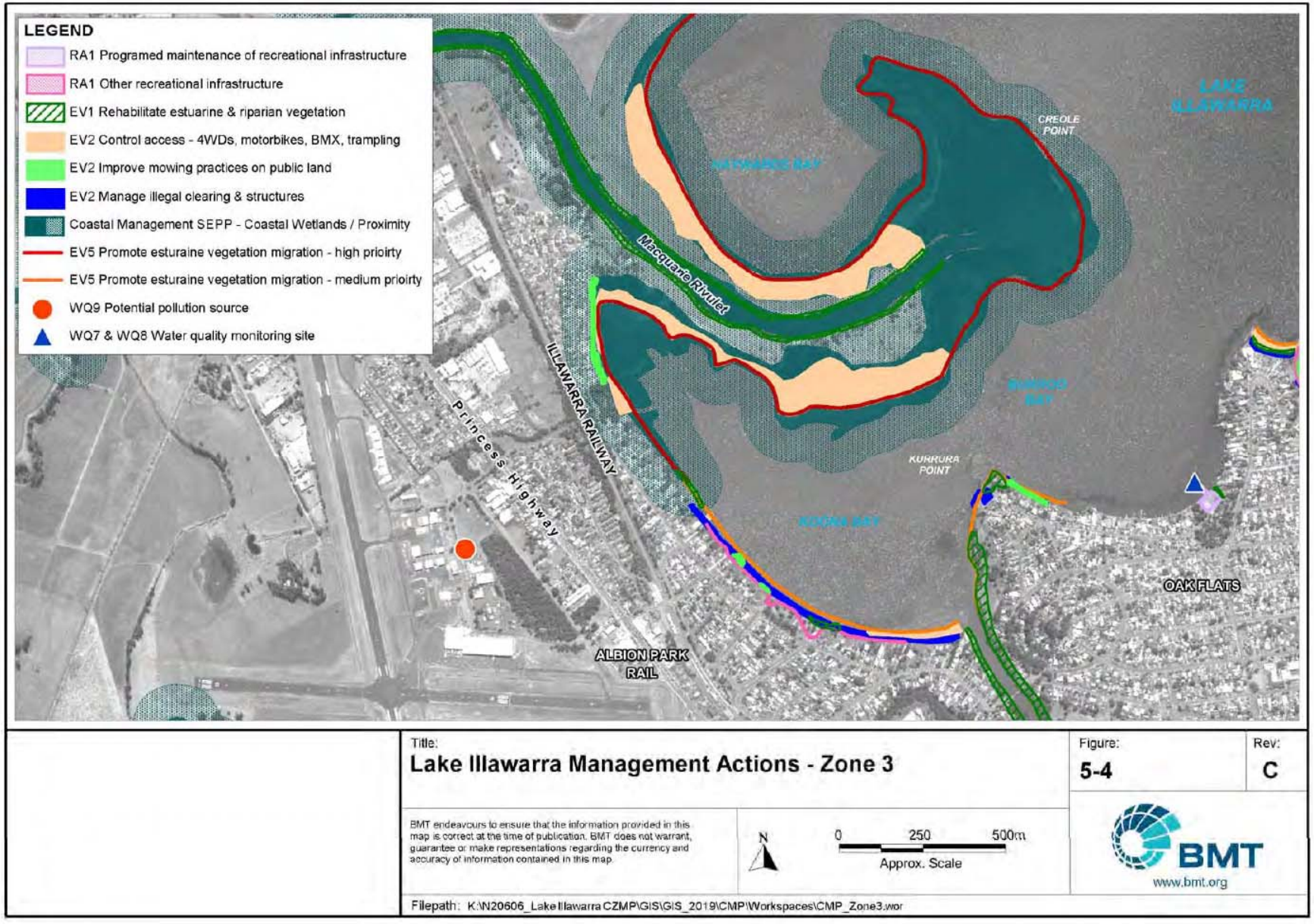
LEGEND
RA1 Programed maintenance of recreational infrastructure
RA1 Other recreational infrastructure
EV1 Rehabilitate estuarine & riparian vegetation
EV2 Control access - 4WDs, motorbikes, BMX, trampling
EV2 Improve mowing practices on public land
EV2 Manage illegal clearing & structures
Coastal Management SEPP - Coastal Wetlands / Proximity
EV5 Promote esturaine vegetation migration - high priority
EV5 Promote esturaine vegetation migration - medium priority
WQ9 Potential pollution source
WQ7 & WQ8 Water quality monitoring site
LAKE ILLAWARRA
CREOLE POINT
Macquarie Rivulet
ILLAWARRA RAILWAY
Princes Highway
KURRURA POINT
OAK FLATS
ALBION PARK RAIL
Title:
Lake Illawarra Management Actions - Zone 3
Figure:
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Title:
Lake Illawarra Management Actions - Zone 4

Figure: **5-5**

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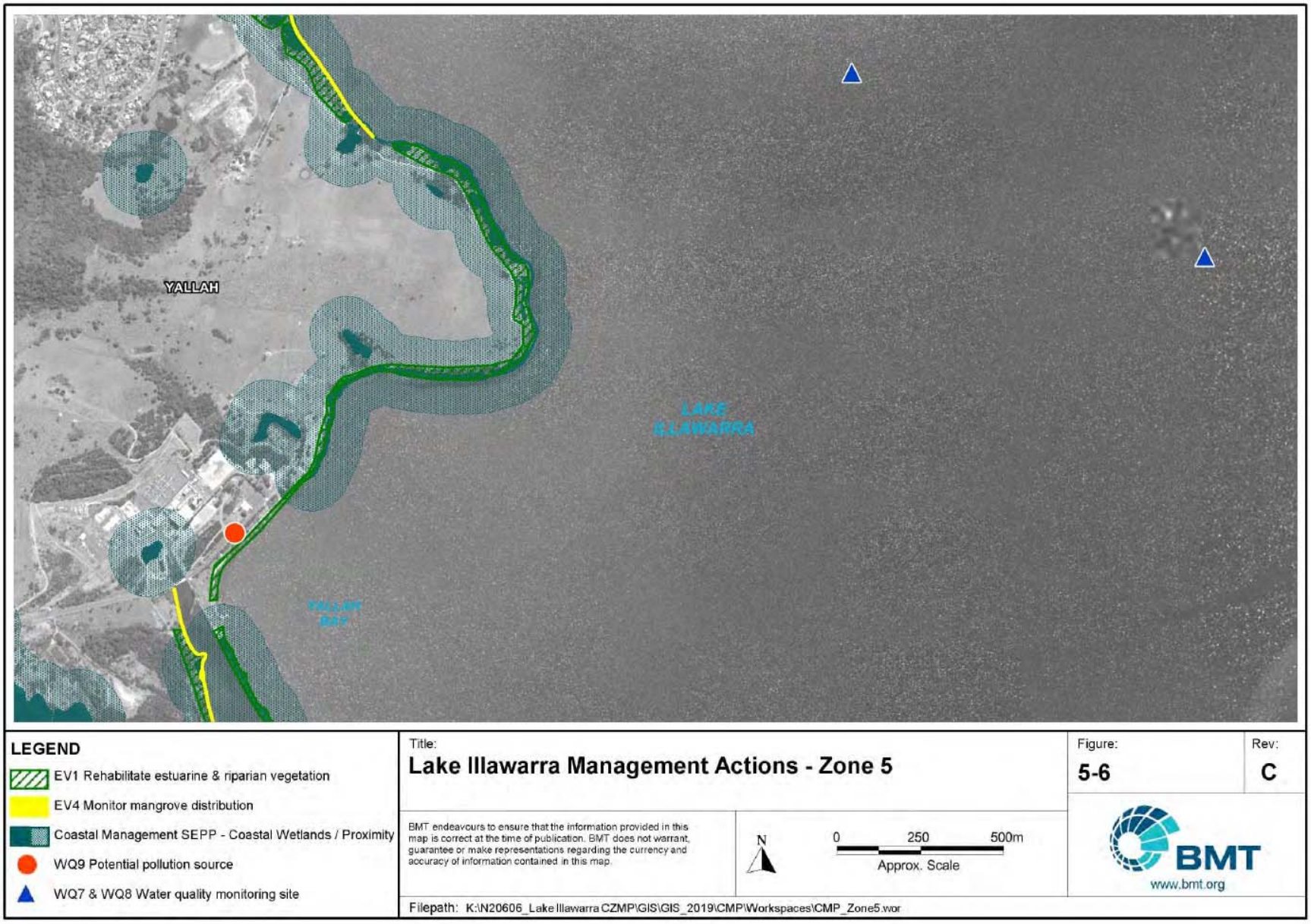
YALLAH
LAKE ILLAWARRA
YALLAH BAY
LEGEND
EV1 Rehabilitate estuarine & riparian vegetation
EV4 Monitor mangrove distribution
Coastal Management SEPP - Coastal Wetlands / Proximity
WQ9 Potential pollution source
WQ7 & WQ8 Water quality monitoring site
Title:
Lake Illawarra Management Actions - Zone 5
Figure:
5-6
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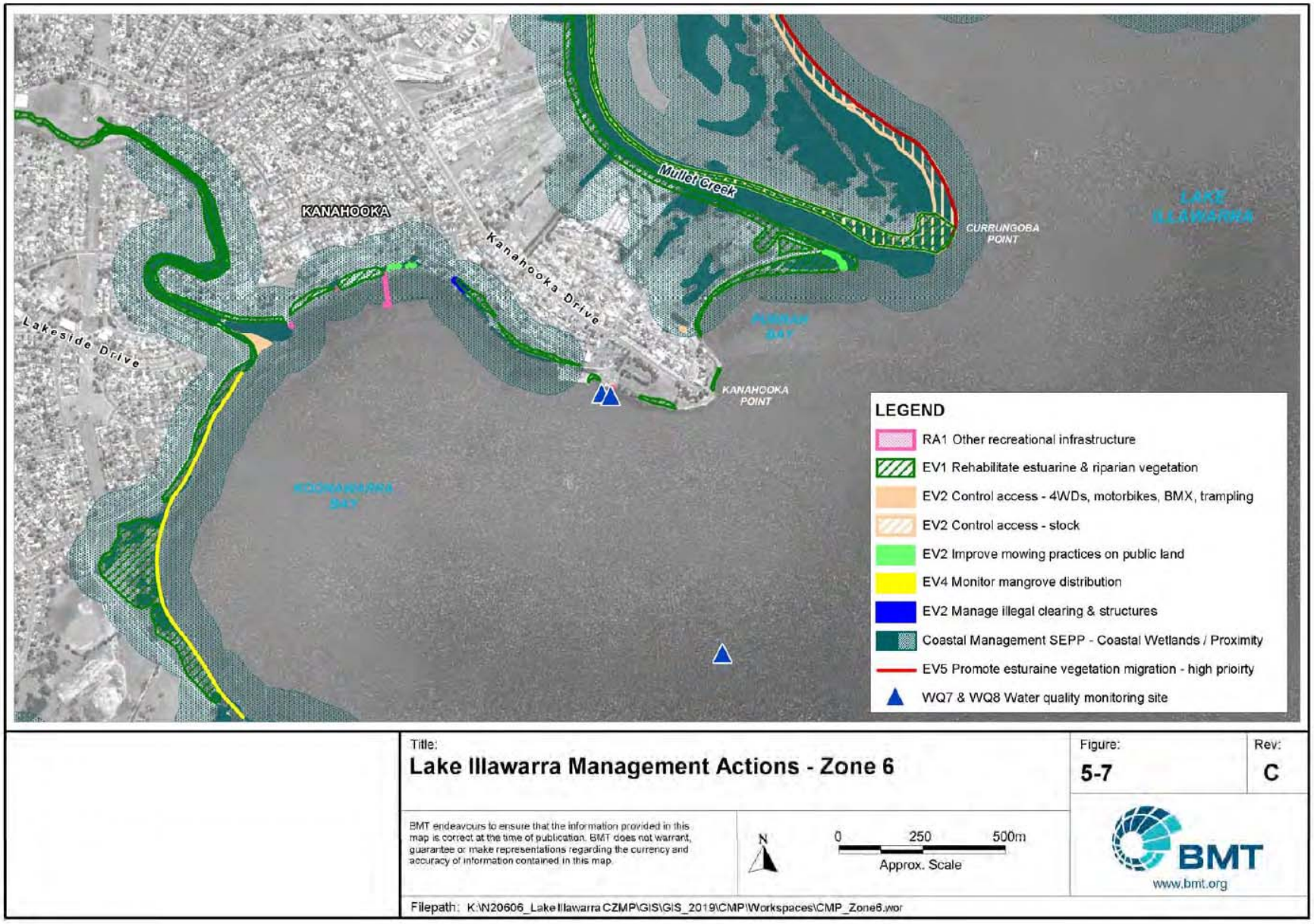
KANAHOOKA
Mullet Creek
Kanahooka Drive
Lakeside Drive
CURRUNGOBA POINT
LAKE ILLAWARRA
KANAHOOKA POINT
KOONAWARRA BAY
LEGEND
RA1 Other recreational infrastructure
EV1 Rehabilitate estuarine & riparian vegetation
EV2 Control access - 4WDs, motorbikes, BMX, trampling
EV2 Control access - stock
EV2 Improve mowing practices on public land
EV4 Monitor mangrove distribution
EV2 Manage illegal clearing & structures
Coastal Management SEPP - Coastal Wetlands / Proximity
EV5 Promote esturaine vegetation migration - high priorty
WQ7 & WQ8 Water quality monitoring site
Title:
Lake Illawarra Management Actions - Zone 6
Figure:
5-7
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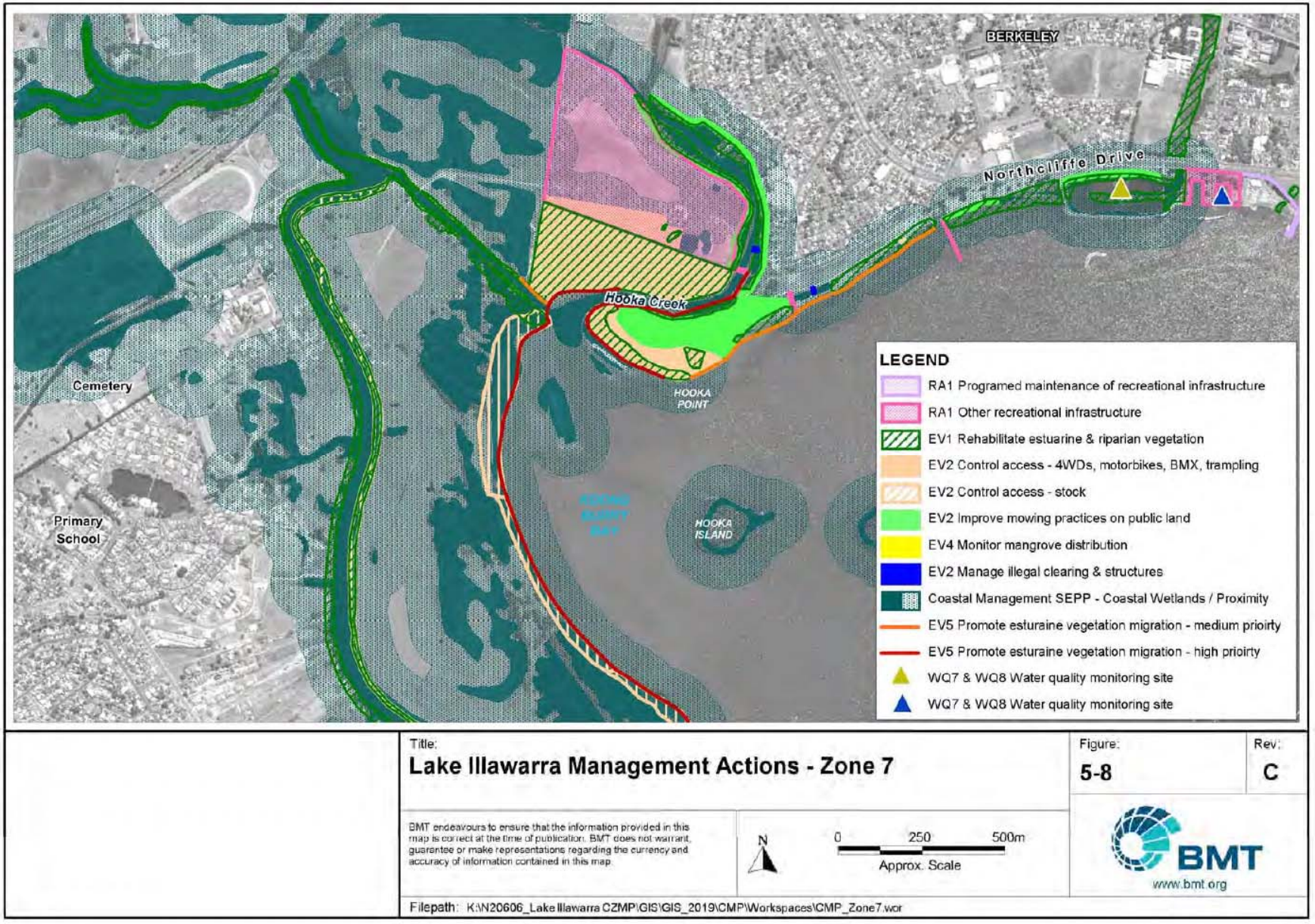
BERKELEY
Northcliffe Drive
Hooka Creek
HOOKA POINT
Cemetery
Primary School
HOOKA ISLAND
LEGEND
RA1 Programed maintenance of recreational infrastructure
RA1 Other recreational infrastructure
EV1 Rehabilitate estuarine & riparian vegetation
EV2 Control access - 4WDs, motorbikes, BMX, trampling
EV2 Control access - stock
EV2 Improve mowing practices on public land
EV4 Monitor mangrove distribution
EV2 Manage illegal clearing & structures
Coastal Management SEPP - Coastal Wetlands / Proximity
EV5 Promote esturaine vegetation migration - medium priority
EV5 Promote esturaine vegetation migration - high priority
WQ7 & WQ8 Water quality monitoring site
WQ7 & WQ8 Water quality monitoring site
Title:
Lake Illawarra Management Actions - Zone 7
Figure:
5-8
Rev:
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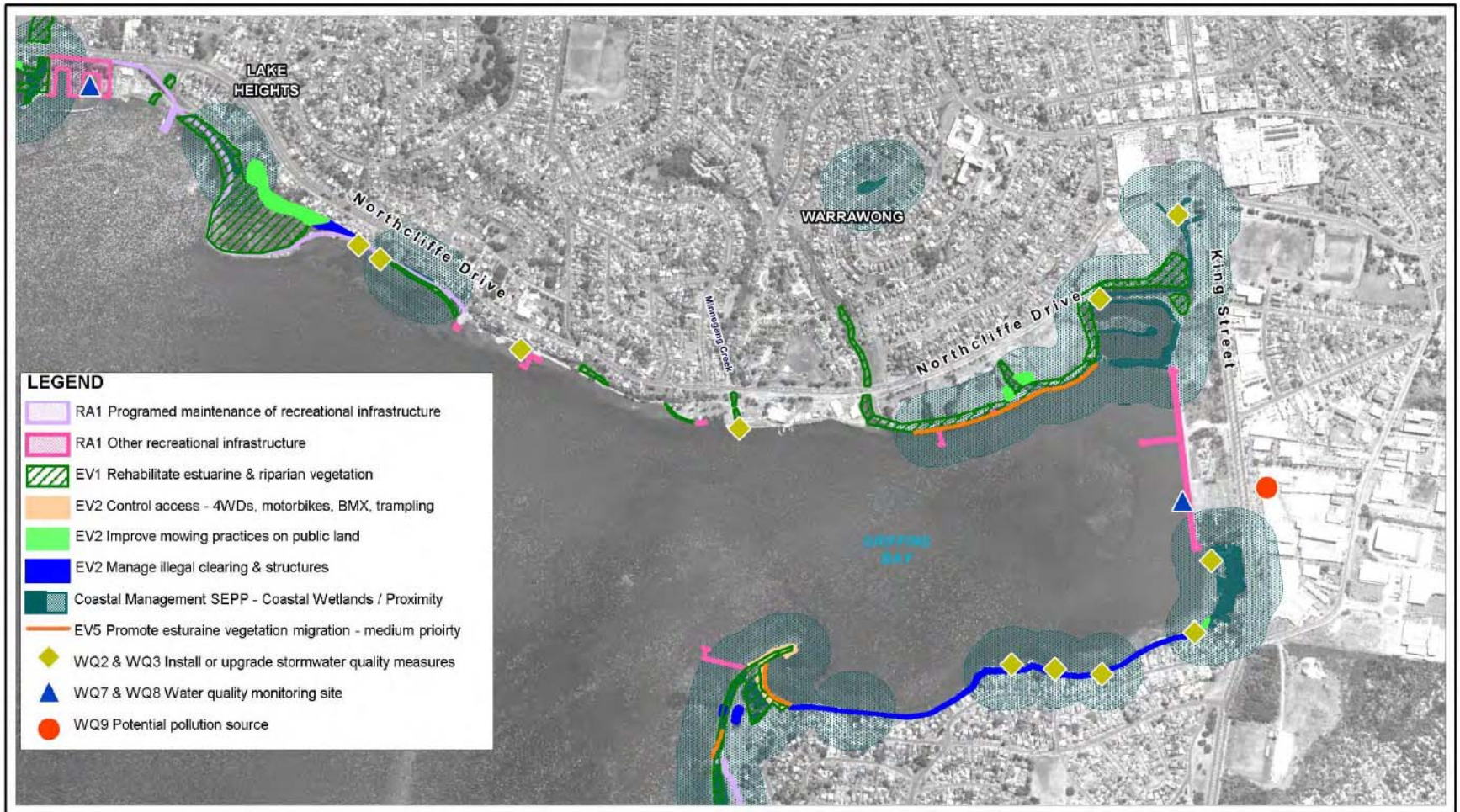

Title:
Lake Illawarra Management Actions - Zone 8

Figure: **5-9**

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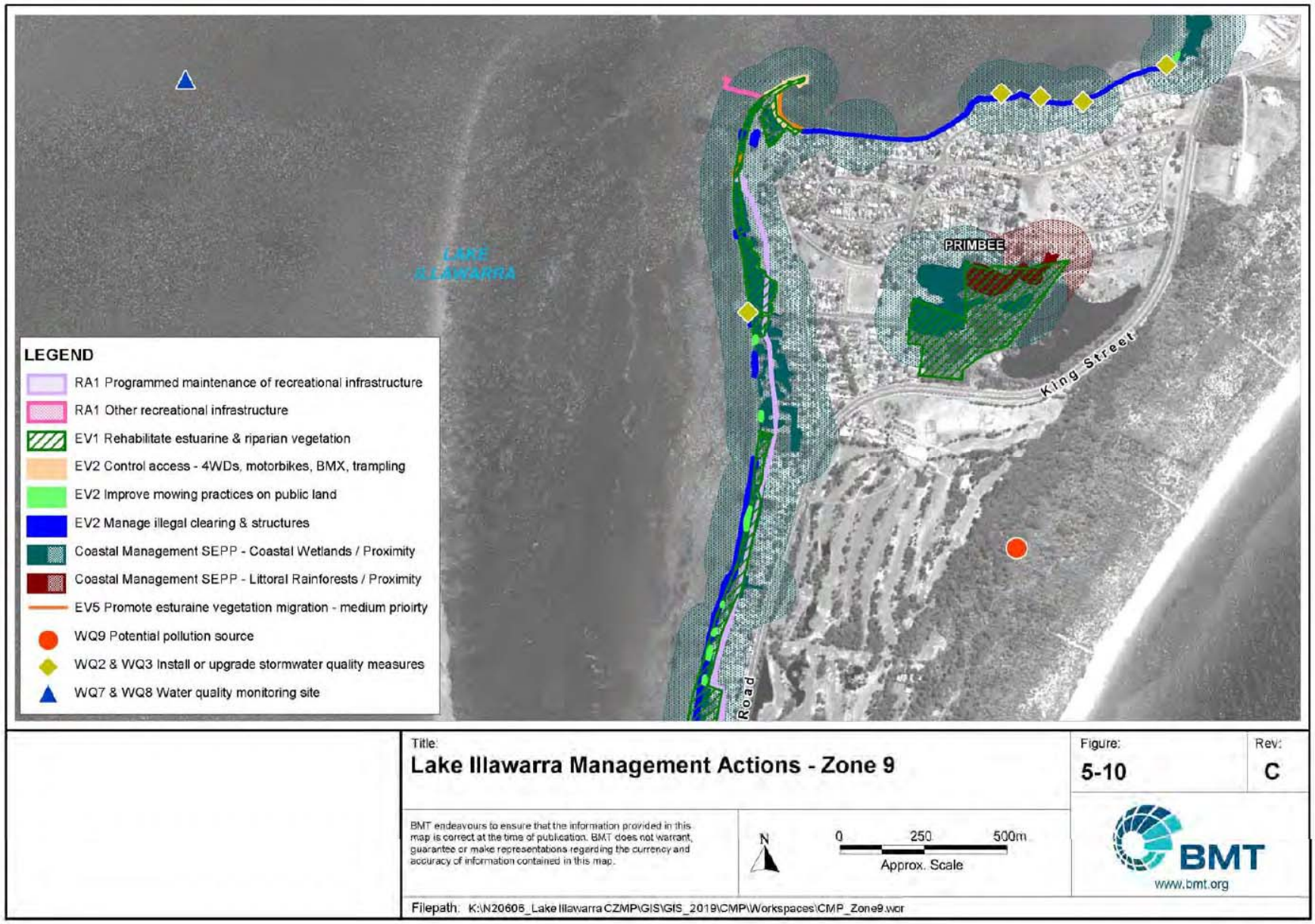
LAKE ILLAWARRA
PRIMBEE
King Street
Road
LEGEND
RA1 Programmed maintenance of recreational infrastructure
RA1 Other recreational infrastructure
EV1 Rehabilitate estuarine & riparian vegetation
EV2 Control access - 4WDs, motorbikes, BMX, trampling
EV2 Improve mowing practices on public land
EV2 Manage illegal clearing & structures
Coastal Management SEPP - Coastal Wetlands / Proximity
Coastal Management SEPP - Littoral Rainforests / Proximity
EV5 Promote esturaine vegetation migration - medium prioirty
WQ9 Potential pollution source
WQ2 & WQ3 Install or upgrade stormwater quality measures
WQ7 & WQ8 Water quality monitoring site
Title:
Lake Illawarra Management Actions - Zone 9
Figure:
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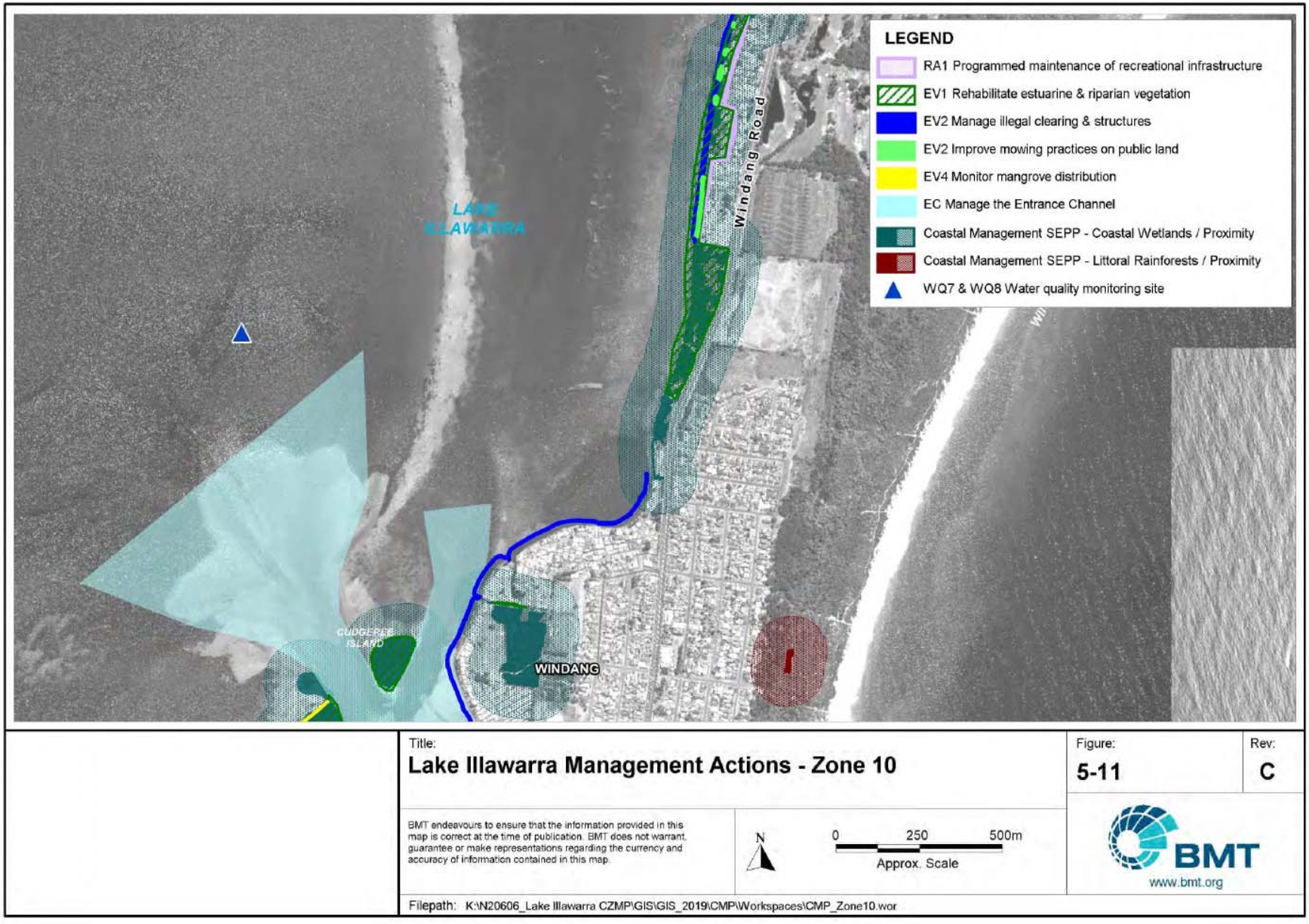
LEGEND
RA1 Programmed maintenance of recreational infrastructure
EV1 Rehabilitate estuarine & riparian vegetation
EV2 Manage illegal clearing & structures
EV2 Improve mowing practices on public land
EV4 Monitor mangrove distribution
EC Manage the Entrance Channel
Coastal Management SEPP - Coastal Wetlands / Proximity
Coastal Management SEPP - Littoral Rainforests / Proximity
WQ7 & WQ8 Water quality monitoring site
LAKE ILLAWARRA
Windang Road
CUDGERES ISLAND
WINDANG
Title:
Lake Illawarra Management Actions - Zone 10
Figure:
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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 speciesthreatened species such as the Little Tern. 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 37 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 is yet to be securedwill 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 $43,300,000 over 10 years, plus an estimated $27,500,000 for long term entrance channel works following action EC1$37,355,000 over 10 years. Existing staff resources in the Councils and DPIE - Coasts & Estuaries OEH 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 the Lake Illawarra Estuary Management Committeea Stakeholder Reference Group. Each individual council will still be the ultimate decision maker but is expected to provide updates to the CommitteeStakeholder Reference Group.

Based upon the timeframes for actions and estimated costings, $4,693,000$3,236,500 is required in Year 1 to implement specified actions. A forecast $29,537,000$15,166,000 is estimated across Year 2 to 5 (inclusive), with a final $36,570,000$18,932,500 required over Years 6 to 10 for the plan. 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 ~~reliably~~ 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, ~~this~~ 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.

Table 6-1 Cost Estimates for CMP Implementation

INSERT TABLE 6-1 PDF

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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 ~~a common understanding~~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~~Table 6-2~~~~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. ~~This action requires a total investment of ~ $110,000 p.a. (split across both Councils, increasing over time) to fund the staff required to implement the CMP. Via this specific resource, i~~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, ~~as well as reviewed annually~~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).

Funding Source	Details
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 ~~OEH~~. 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~~OEH~~ 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~~OEH~~. Suitable coastal management grant applications may relate to dune care, for example.
~~Public Reserve Management Fund~~Crown Reserves Improvement Fund (CRIF)	The ~~Crown Reserve Management Improvement Fund (~~CRIF~~)~~ is administered by DP~~O~~IE – 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.

Funding Source	Details
NSW Heritage Grant Programs	This program is administered by DPIE~~OEH~~ 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.

Funding Source	Details
~~National Trusts Program~~	~~The Australia Government Department of Environment administers this program. The Trusts program provides funding for works to preserve and enhance Australian cultural heritage. The Australian Council of National Trusts coordinates activities under the program with National Trusts offices in each State and Territory. Funds may be available for items of Australian cultural heritage within the coastal environment.~~

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 plan. The responsible organisation is expected to lead implementation of an action and ~~commit~~ 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.

Once the plan 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 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). 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 ~~for Action EC2 (Implement options to manage erosion using environmentally sensitive methods). Entrance processes and ongoing changes in these processes as a result of entrance training~~Short and long term management measures for erosion / accretion in the entrance channel shall be undertaken through ~~will be investigated through~~ Action EC1, with immediate actions permissible through EC3 ~~(Investigate Entrance Channel Processes and Management)~~. 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~~, although the risk of this is considered low~~.

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 ~~37~~ 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~~~~Table 6-3~~.

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

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7 Monitoring, Evaluation and Reporting ~~and Review~~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~~OEH Coastal~~ 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 ~~i~~has 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

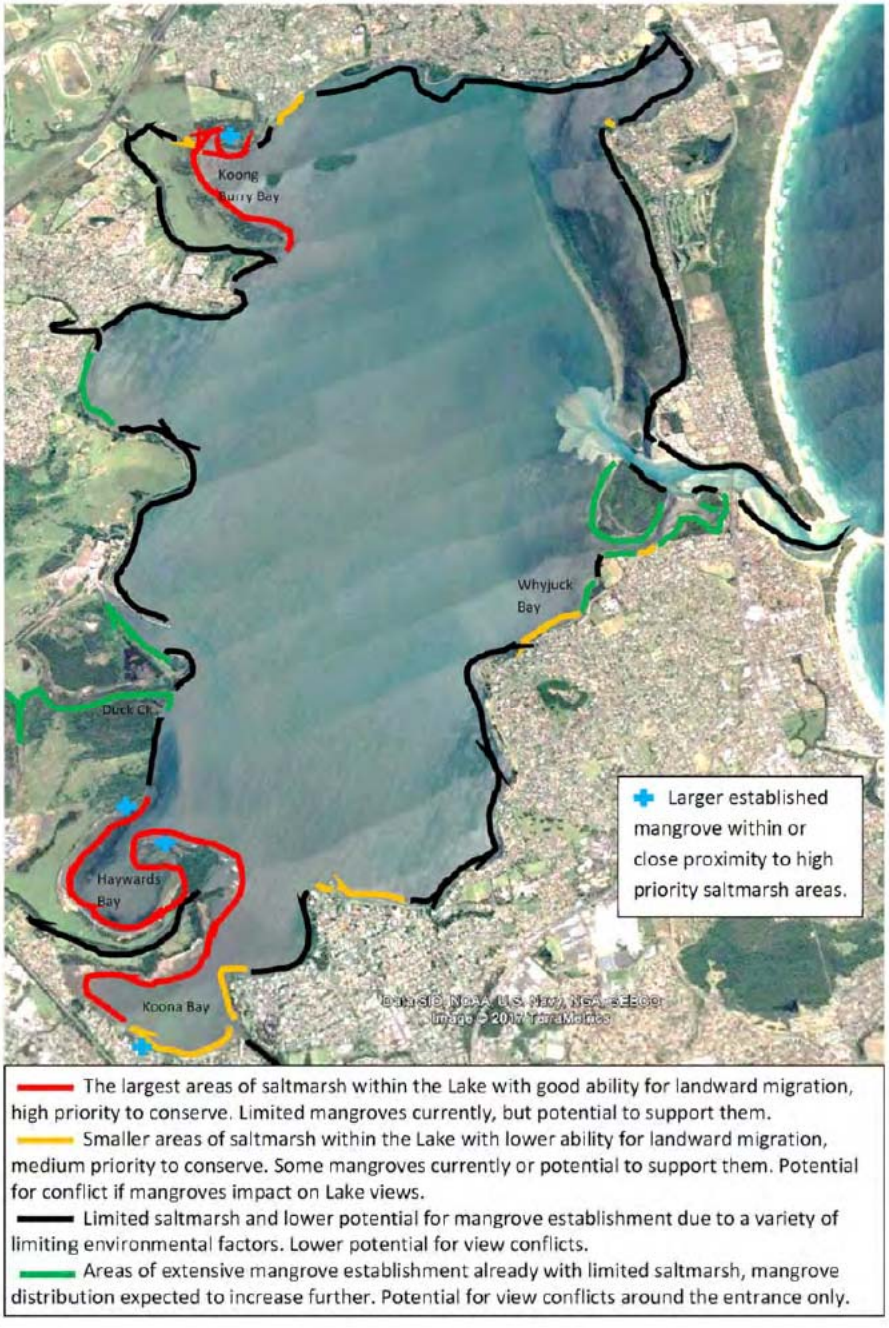
Table 7-2 Location of Water Quality Monitoring Sites in Lake Illawarra

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 Edgee	
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*~~D~~1, ~~Appendix F~~) and as sea level rises (see Figure 7-2) ~~and which~~ could be investigated further for this purpose ~~(tidal inundation map, in Appendix F, adapted from Coastal Risk Australia)~~. 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.



~~Figure 7-2 Foreshore prioritisation map to guide where effort on mangrove monitoring and conservation of saltmarsh distribution is best placed (reproduced from Williams and Wiecek, 2017)~~

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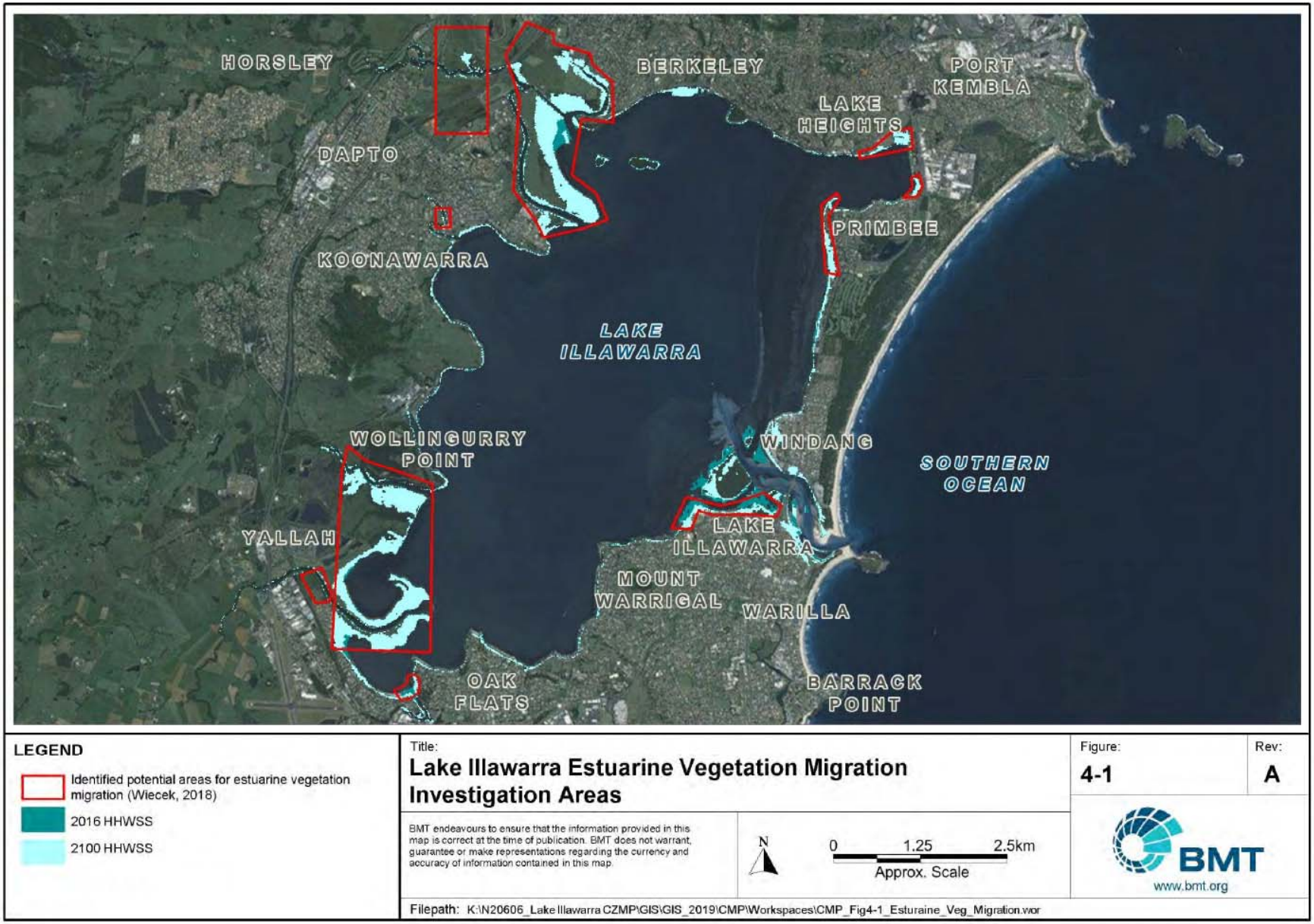
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WINDANG
SOUTHERN OCEAN
YALLAH
LAKE ILLAWARRA
MOUNT WARRIGAL
WARILLA
OAK FLATS
BARRACK POINT
LEGEND
Identified potential areas for estuarine vegetation migration (Wiecek, 2018)
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Appendix A NSW Coastal 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. ~~The Department of Planning and Environment (DPE)~~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 ~~OEH~~ (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 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 both the current Guidelines for preparing coastal zone management plans (OEH, 2013) and 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	The Minister has not directed the local councils in preparation of this CMP.

Section 14 of the Coastal Management Act 2016 defines the preparation of CMPs as follows		How this CMP addresses these requirements
	between it and the coastal management manual.	
(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.
	(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, 20202019b) in Appendix AAppendix A0.
	(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)**Error! Reference source not found.**.
	(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.

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
	(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.
	(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 1.1.~~11.~~1.~~11.~~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 plan does not deal with such matters.

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
(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.

Table A-3 Essential Elements for a Coastal Management Program Relevant to Preparation of the CMP

Draft essential elements associated with Section 14 of the CM Act: Preparation of CMPs		How this CMP addresses these elements
4)	A CMP is to be prepared using the staged process set out in the manual (see Figure 3 of the Introduction for an outline of the five stages), noting that all stages do not need to be completed if they are not relevant.	The Lake Illawarra CMP has been prepared in accordance with both the current Guidelines for preparing coastal zone management plans (OEH, 2013) and the NSW Coastal Management Manual (OEH, 2018) that was current at the time of this CMP's preparation.
5)	All councils commencing the preparation or review of a CMP must complete Stage 1 (scoping study) of the process. At the conclusion of the scoping study, councils should take the opportunity to seek advice from DPIE~~OEH~~ and the Coastal Council on which of the subsequent stages are applicable.	A scoping study has been compiled by WCC and SCC. Advice from DPIE~~OEH~~ was sought, and stated that the Lake Illawarra project could be completed as a CMP. Prior stages of preparing this CMP included the *Lake Illawarra Information Synthesis Report* (BMT, 2020a)~~an Information Synthesis Report~~ detailing current knowledge of the Lake's processes~~(Appendix B)~~, and a Community Uses, Values, Threats and Opportunities Lake Illawarra report (Appendix A~~Appendix A~~0). Stakeholder and community engagement was undertaken throughout the studies.
6)	Councils should take the opportunity to seek advice from DPIE~~OEH~~ and the Coastal Council at the conclusion of key stages of the CMP process.	At each stage of the preparation of this CMP, DPIE~~OEH~~ has been involved in the review of documents and provided guidance on subsequent stages of the CMP.
7)	Councils should submit a draft CMP that is consistent with the requirements of the Manual to DPIE~~OEH~~. After exhibition of the draft CMP, Councils should provide a copy of the final draft of the CMP to DPIE~~OEH~~ for review before it is submitted to the Minister for certification. The Minister may refer the CMP to the Coastal Council for advice before the Minister considers certification.	This is the process to be followed for the Lake Illawarra CMP certification.
8)	Councils should identify priority objectives for their coastal management areas. When identifying objectives for a CMP that includes one or more coastal management areas, councils must be consistent with the objectives for coastal management areas as required by the draft CM Bill and proposed CM SEPP. The objectives must align with the objectives identified by the local community in developing the Community Strategic Plan.	The objectives for this CMP have been aligned with the objectives specified in the CM Act, see Section 1.5

Draft essential elements associated with Section 14 of the CM Act: Preparation of CMPs	How this CMP addresses these elements
9) Councils should identify the priority management issues and opportunities affecting the coastal zone where the program is to apply. These may relate to: a) coastal processes and environmental values b) social and cultural values c) Aboriginal values d) coastal economies e) coastal development and land use planning f) current and future risk from coastal hazards and climate change g) the ambulatory nature of the shoreline h) integration and coordination of planning and management i) resilience of coastal assets j) public participation, and k) marine estate. l) What outcomes are required from a CMP process	A comprehensive assessment of coastal management issues and opportunities has been undertaken as part of this Lake Illawarra CMP. Coastal management issues and opportunities affecting the Lake were identified primarily through the *Lake Illawarra Information Synthesis Report* (BMT, 2020a) ~~the Synthesis Report (Appendix B)~~ and the *Community Uses, Values, Threats and Opportunities Lake Illawarra* Report (BMT, 2020b)~~Community Uses, Values, Threats and Opportunities Lake Illawarra Report (Appendix A)~~ completed as a precursor to this CMP.
10) The CMP should be developed after the preparation of:	
a) a Coastal Strategy Statement. The Strategy Statement sets the long-term strategy for the integrated and coordinated management of the coastal zone with a focus on achieving the objectives of the draft CM Bill. This includes identification of: i. coastal management issues and opportunities ii. strategies and actions linked to coastal management areas covered by the CMP, including a map of proposed actions	A coastal strategy statement for this CMP has been prepared in Section 1.5.

Draft essential elements associated with Section 14 of the CM Act: Preparation of CMPs	How this CMP addresses these elements
b) specific trigger points or indicators of when a strategic approach will no longer be viable. This should be based on thresholds for intolerable and unacceptable risk at that locality.	Strategy "Prepare for Inundation Risks" in Section 4.8 provides the strategies through which trigger points and indicators will be implemented. A tidal inundation risk assessment was conducted for this CMP, and combined with the existing coastal inundation risk registers already completed for the Lake provides detail regarding the specific assets (including natural assets) at risk over specified future timeframes.
identification of coastal management actions that are council's responsibility, and are consistent with the Strategy Statement. After certification and adoption of the CMP, the final council actions will be incorporated in council's IP&R framework and land use planning system	The Strategy Implementation Plan in Chapter 4 identifies the responsibilities for implementation (lead and support), including the local councils (WCC and SCC) and other public authorities. The implementation tables also provide details to enable the actions to be implemented through both councils IP&R Frameworks.
c) identification of coastal management actions that are consistent with the Strategy Statement and require coordination with adjoining councils or are the responsibility of public authorities. The draft CMP should include an acknowledged acceptance of these management actions where they include public authority responsibilities and/or coordination with adjoining councils prior to certification by the Minister, and	The Strategy Implementation Plan in Chapter 4 identifies the responsibilities for implementation (lead and support), including the local councils (WCC and SCC) and other public authorities. 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. Acknowledged acceptance of their roles shall be provided prior to certification of the CMP.
d) a business plan to demonstrate viable funding of proposed actions.	A business plan for the CMP is provided in Chapter 6.
A CMP should include: e) a summary statement of the overall CMP Strategy that demonstrates how the CMP provides an integrated and sustainable program of coastal management in line with the Objectives in the CM Bill, any regional objectives and the objectives of the council	Overarching summary statements regarding the purpose, intent, context and objectives of this CMP are delivered in Chapter 1.
f) coastal management actions to be implemented by council through IP&R and land use planning processes which are consistent with the Strategy Statement and are the responsibility of the council, in addition the actions to be implemented by adjoining councils (where relevant) and public authorities	The Strategy Implementation Plan in Chapter 4 identifies the responsibilities for implementation (lead and support), including the local councils (WCC and SCC) and other public authorities. The implementation tables also provide details to enable the actions to be implemented through both councils IP&R Frameworks. The implementation tables also indicate those actions to be implemented through changes to the LEP, DCP or other planning documents.
g) a brief summary of the business plan outlining the key components of the funding strategy for the proposed actions	A business plan for the CMP is provided in Chapter 6.

Draft essential elements associated with Section 14 of the CM Act: Preparation of CMPs	How this CMP addresses these elements
h) where the CMP is being prepared for a coastal vulnerability area, a coastal erosion emergency action sub-plan, and	As outlined in detail in Section 1.7.3, present day inundation risks are currently effectively managed through the Flood Risk Emergency Management process.
i) a map (or maps) showing linked actions for each relevant coastal management area along the coast. These maps should include adjoining local council areas where cross boundary management needs to be consistent or fully aligned to address issues such as regional scale sediment compartment processes, or where an estuary or wetland and its catchment straddles a council boundary.	Management Strategy Maps for the Lake are provided in Chapter 5.
Supporting documentation for a CMP will include: j) a detailed Coastal Strategy Statement which provides context and objectives and establishes council's strategic direction(s) for the coast	A coastal strategy statement for this CMP has been prepared in Section 1.5.
k) a detailed business plan for implementation of the CM, and	A business plan for the CMP is provided in Chapter 6.
l) a listing of all detailed reports relied on in the preparation of the CMP, and a statement as to how to publicly access any of the listed documents.	Previous studies supporting this CMP are discussed in Section 1.9, and includes the *Lake Illawarra Information Synthesis Report* (BMT, 2020a). The Synthesis Report is provided in Appendix B, and a Community Uses, Values, Threats and Opportunities Lake Illawarra report is provided in Appendix AAppendix A0.

Draft essential elements associated with Section 14 of the CM Act: Preparation of CMPs	How this CMP addresses these elements
11) Councils should identify management actions which reduce risks and contribute to achieving the proposed strategic direction for each coastal management unit. Proposed management responses should reduce consequences or reduce the likelihood of a hazard or threat affecting a vulnerable asset (natural, social or economic). These responses should: a) reflect the vulnerability and opportunities in the coastal management program area b) reduce risks affecting coastal ecosystems and biodiversity and identify opportunities to improve the health of coastal ecosystems c) identify opportunities to improve coastal use, access and amenity, and coast dependent economic activity, and d) be identified in consultation with stakeholders.	The process for identifying management actions is outlined in Chapter 3, with the strategies assessment outcomes documented in the *Lake Illawarra CMP Management Actions Assessment* (BMT, 2020c)~~**Error! Reference source not found.**~~. The process included a detailed multicriteria cost benefit analysis of the options, including assessment of the options direct influence on the threats to the Lake, in order to identify suitable actions for the CMP.
12) Councils must develop a business plan that demonstrates viable funding mechanisms for proposed coastal management actions that are consistent with their IP&R Resourcing Strategy. In the business plan: a) councils should identify and consider the full capital, operational and maintenance costs of potential coastal management actions b) councils should identify the distribution of costs and benefits of potential management actions. The distribution analysis should consider council, agency, directly affected coastal community stakeholders (such as landholders in coastal hazard areas), indirectly affected coastal community stakeholders and the environment, and c) the costs of coastal management actions should be apportioned among beneficiaries, taking into account capacity to pay.	A business plan for the CMP is provided in Chapter 6.

Draft essential elements associated with Section 14 of the CM Act: Preparation of CMPs	How this CMP addresses these elements
13) If a CMP is prepared to address a coastal vulnerability area, that program should include all parts of the coastal zone that are: a) vulnerable to existing or potential hazards (including extreme events), or b) likely be affected by coastal hazards over a defined planning horizon. c) This could include the waters, beaches, dunes and headlands of the open coast, the waters, shorelines and riparian areas of coastal lakes and the shorelines, and the waters, banks, riparian areas and floodplains of estuaries, as far upstream as the tidal limit.	This CMP sets out the process for defining the coastal vulnerability area for Lake Illawarra, refer to Section 1.1.1.11.1.1.11.1. Present day inundation risks are currently effectively managed through the Flood Risk Emergency Management process. Coastal inundation for Lake Illawarra was mapped through the course of the Lake Illawarra Floodplain Risk Management Plan (Cardno, 2012), and the Wollongong Coastal Zone Study (Cardno, 2010). A risk assessment was undertaken for coastal inundation in Lake Illawarra, and management strategies developed to address this risk in two key supporting documents to this CMP: • Lake Illawarra Coastal Risk Assessment (BMT WBM, 2013) • Wollongong Coastal Zone Management Plan: Management Study (BMT WBM, 2017). Tidal inundation risks were assessed through a separate hydrodynamic modelling exercise by Kumbier et al (2019) and then a risk assessment was conducted specifically for tidal inundation as documented in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b)~~Values Report~~. Management actions to address future storm and tidal inundation risks are specified in Section 4.8, as well as through other specific actions in the plan.
14) The CMP should be developed to consider potential very large, low probability events and ongoing long-term changes, at timeframes up to, and if appropriate, beyond 100 years. Different levels of hazard and risk assessment detail are appropriate for long-term (less certain) and near-term hazards and risks.	The timeframes and events considered through the course of this CMP are outlined in Section 1.6.
15) The area covered by the CMP should allow for uncertainty about the impacts of future coastal hazards and potential threats to coastal biodiversity and socio-economic assets and their condition.	This CMP sets out the process for defining the coastal vulnerability area for Lake Illawarra, refer to Section 1.1.1.11.1.1.11.1. The threat and risk assessment conducted for this CMP in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b)~~Values Report~~ also considered future changes that will affect the future level of risk from identified threats.

Draft essential elements associated with Section 14 of the CM Act: Preparation of CMPs	How this CMP addresses these elements
16) The planning horizons should consider potential coastal change, including a) climate change, including relative sea level rise b) population growth, and c) projected use of coastal land for infrastructure, housing, commercial, recreational and conservation purposes.	The intended timeframe for implementation of this CMP is 10 years, as consistent with the CM Act. Actions are typically focussed on achieving improvements over this timeframe, with some actions incidentally having a longer term effect. With respect to coastal inundation risks, a longer planning horizon has been considered when developing actions.
17) A CMP may also include opportunities to enhance biodiversity (within coastal wetlands and littoral rainforest areas and coastal environment areas) and social and economic assets and conditions in the coastal zone including enhanced public access and enjoyment of the coastal amenity. The area covered by the CMP should include appropriate buffer areas to allow for uncertainty and change over time.	The Lake Illawarra CMP is focussed on actions to remediate the threats to the Lake and to enhance its environmental and thereby social and economic values. A number of actions in the CMP directly intend to enhance biodiversity, and social and economic assets of the Lake. The area covered by this CMP (as outlined in Section 1.3) provides an appropriate buffer to allow for uncertainty and change over time.

~~Appendix B Lake Illawarra Information Synthesis Report~~

~~Appendix C Community Uses, Values, Threats and Opportunities Lake Illawarra~~

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Lake Illawarra
Coastal Management Program 2020 - 2030

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Shellharbour CITY COUNCIL

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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

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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.

Glossary of Terms

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 $45,300,000 over 10 years, plus an estimated $27,500,000 for long term entrance channel works following action EC1. Based upon the timeframes for actions and estimated costings, $5,193,000 is required in Year 1 to implement specified actions. A forecast $31,037,000 is estimated across Year 2 to 5 (inclusive), with a final $36,570,000 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 Community Strategic Plan.

Once the plan 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.

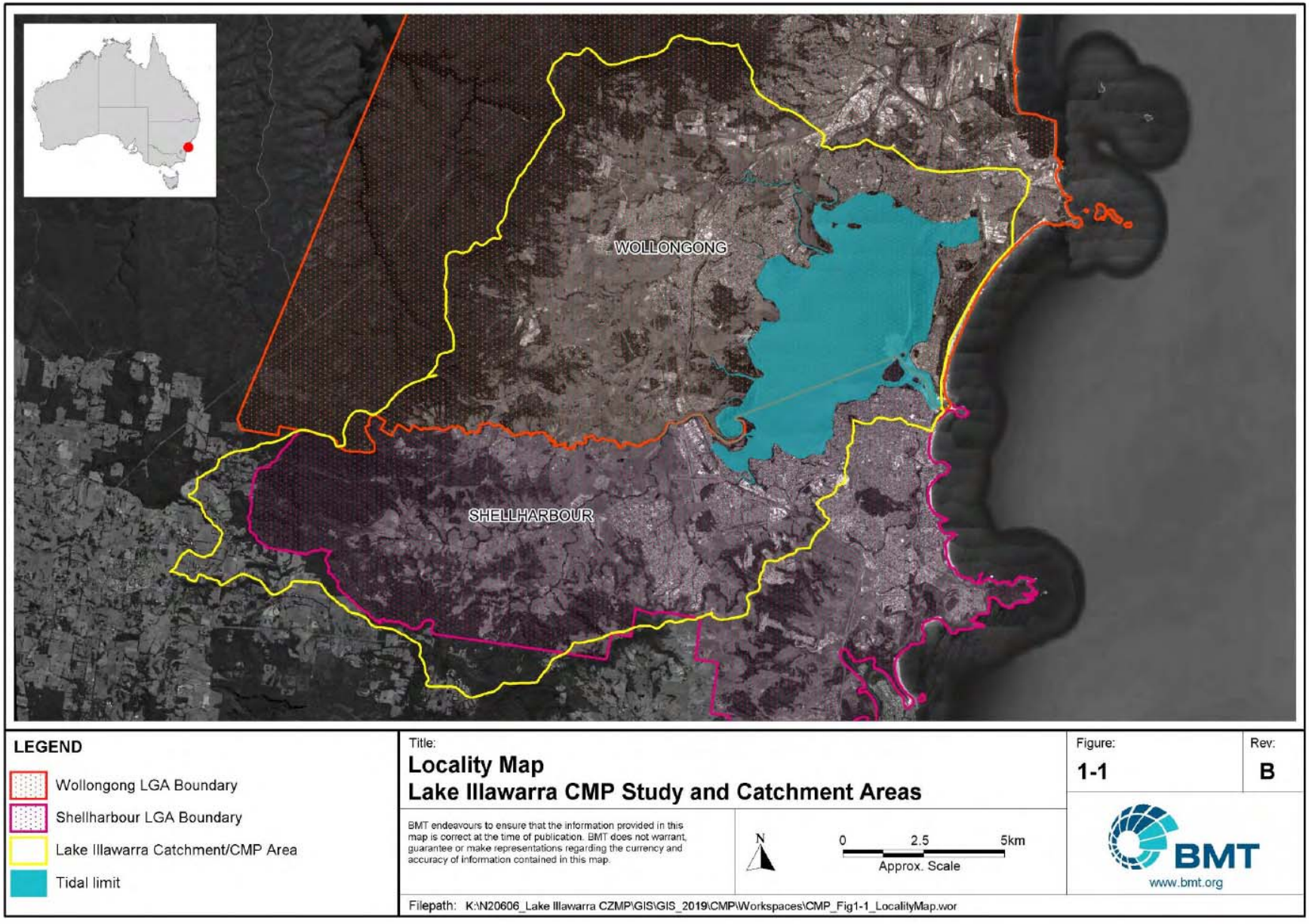
While it is not the intent of this CMP to pursue a planning proposal to adopt a coastal vulnerability area at this time, it is noted that suitable mapping is presently available to do so. This mapping will be used to inform land use planning for the Lake. Cardno (2010, 2012) modelled coastal inundation 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 Options to Manage Erosion and Accretion Changes in the Entrance Channel and Implement Management Solutions	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


WOLLONGONG
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LEGEND
Wollongong LGA Boundary
Shellharbour LGA Boundary
Lake Illawarra Catchment/CMP Area
Tidal limit
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Lake Illawarra CMP Study and Catchment Areas
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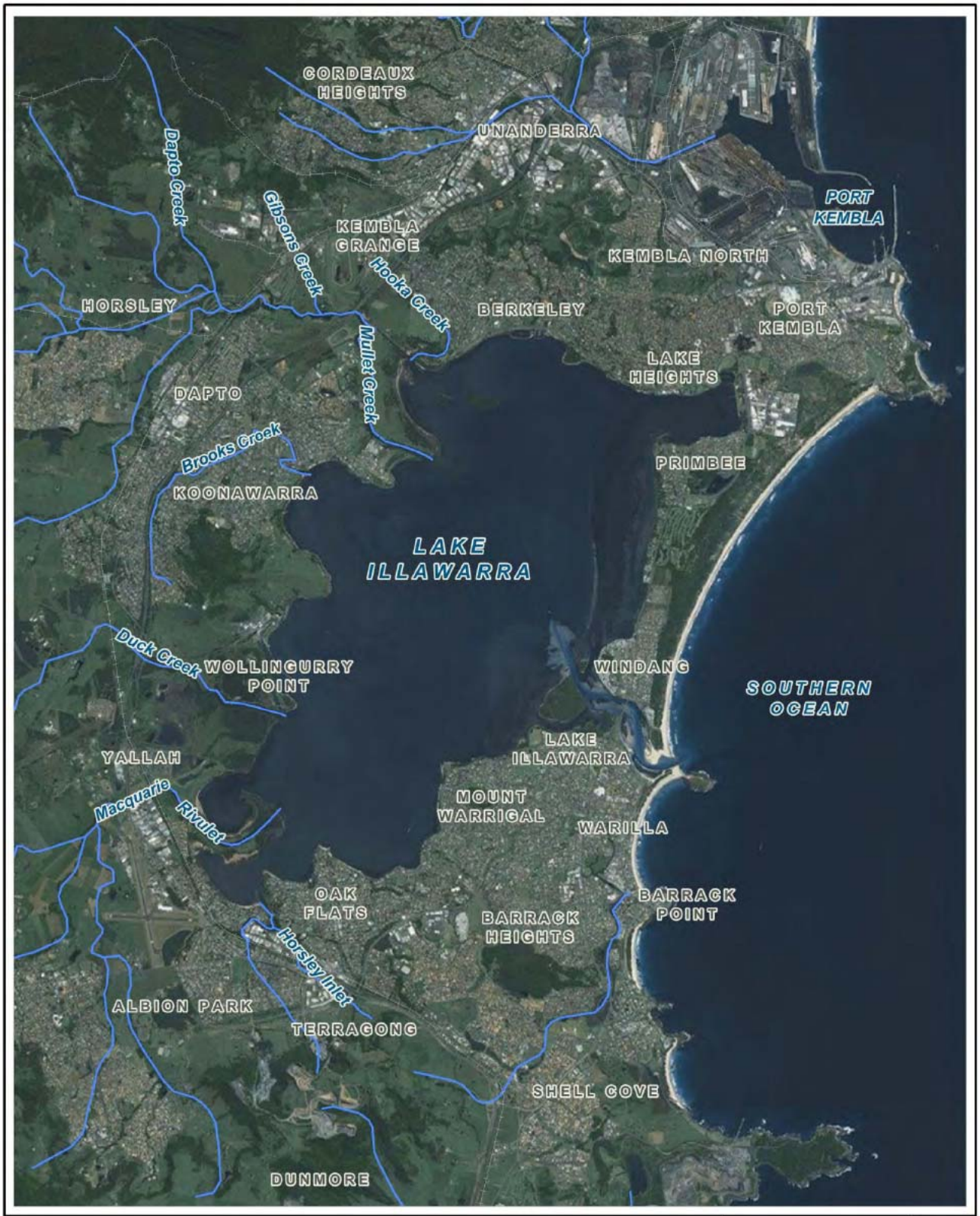

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Lake Illawarra and Waterways

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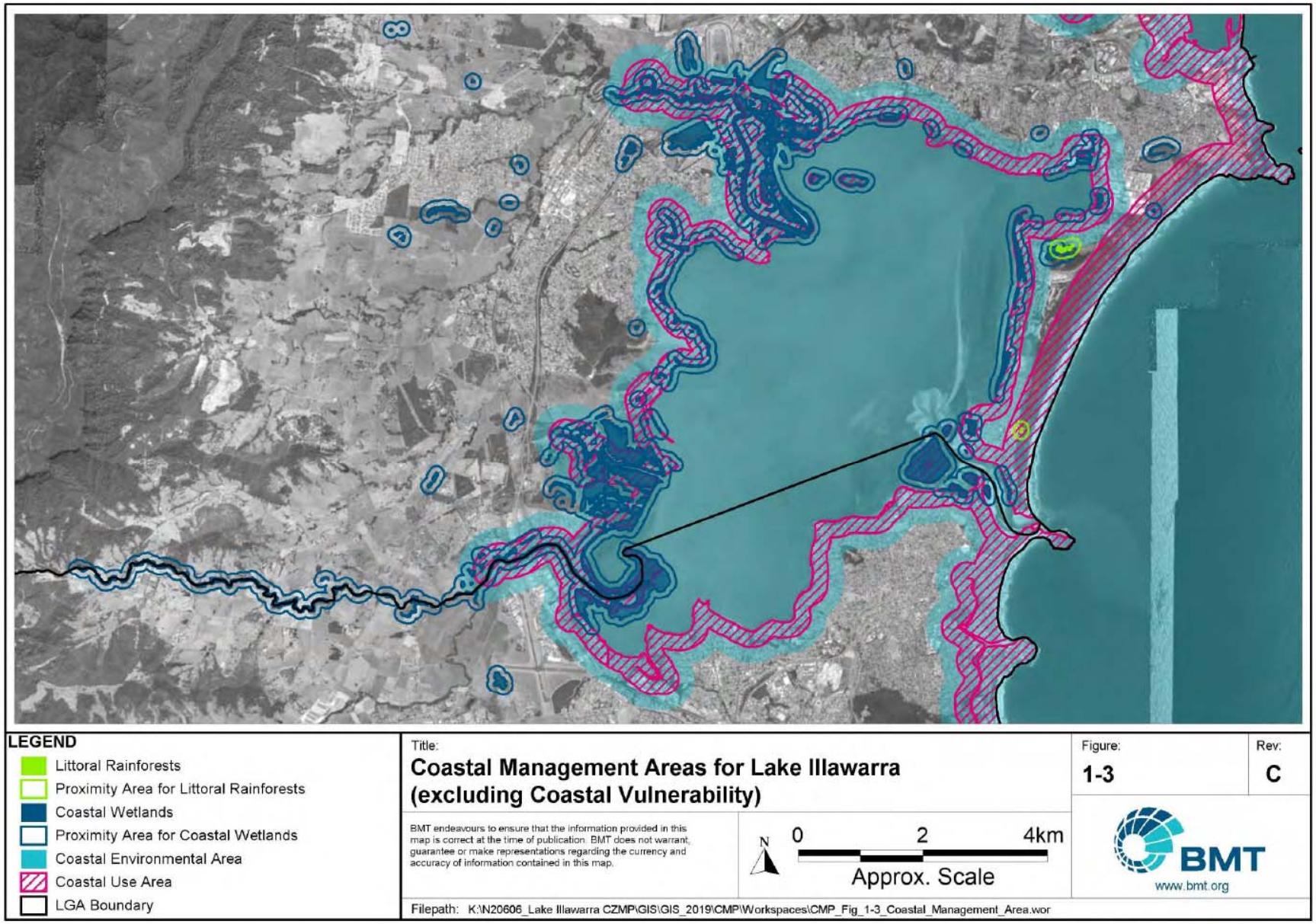
LEGEND
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Proximity Area for Littoral Rainforests
Coastal Wetlands
Proximity Area for Coastal Wetlands
Coastal Environmental Area
Coastal Use Area
LGA Boundary
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1.4 Who is the CMP for?

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 location where they have been incorporated in this report are outlined in Table 1-2.

Table 1-2 Objects of the CM Act and their Consideration within this Report

CM Act Part 1	Objects of the CM Act	Action section in this CMP
Section 3a	to protect and enhance natural coastal processes and coastal environmental values including natural character, scenic value, biological diversity and ecosystem integrity and resilience.	4
Section 3b	to support the social and cultural values of the coastal zone and maintain public access, amenity, use and safety.	4.2, 4.5
Section 3c	to acknowledge Aboriginal peoples' spiritual, social, customary and economic use of the coastal zone.	4.6
Section 3d	to recognise the coastal zone as a vital economic zone and to support sustainable coastal economies.	4
Section 3e	to facilitate ecologically sustainable development in the coastal zone and promote sustainable land use planning decision-making.	4.2, 4.8
Section 3f	to mitigate current and future risks from coastal hazards, taking into account the effects of climate change.	4.3, 4.7, 4.8
Section 3g	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
Section 3h	to promote integrated and co-ordinated coastal planning, management and reporting.	4
Section 3i	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

CM Act Part 1	Objects of the CM Act	Action section in this CMP
Section 3j	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
Section 3k	to support public participation in coastal management and planning and greater public awareness, education and understanding of coastal processes and management actions.	4
Section 3l	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
Section 3m	to support the objects of the *Marine Estate Management Act 2014*.	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 Legislation

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.

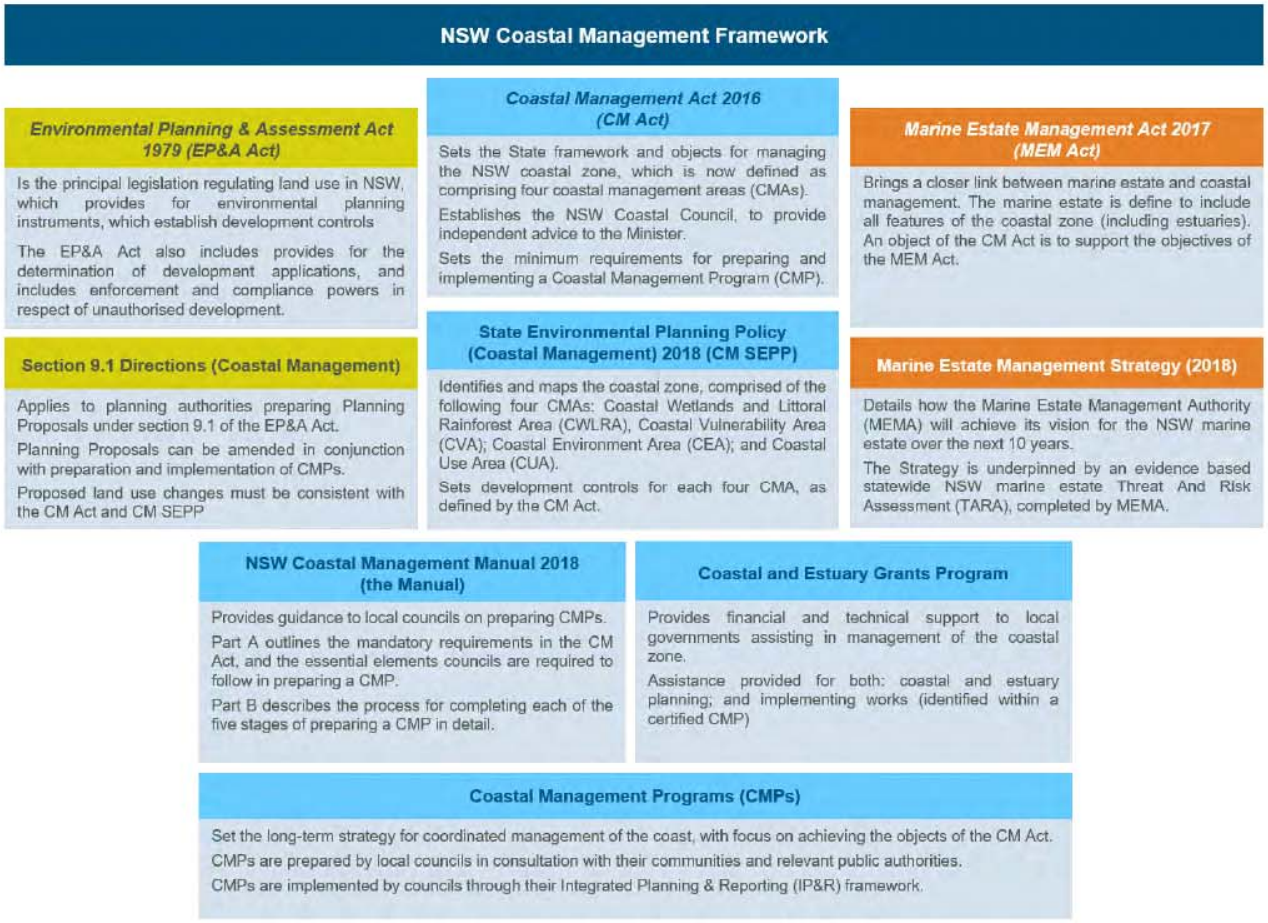


Figure 1-4 NSW Coastal Management Framework

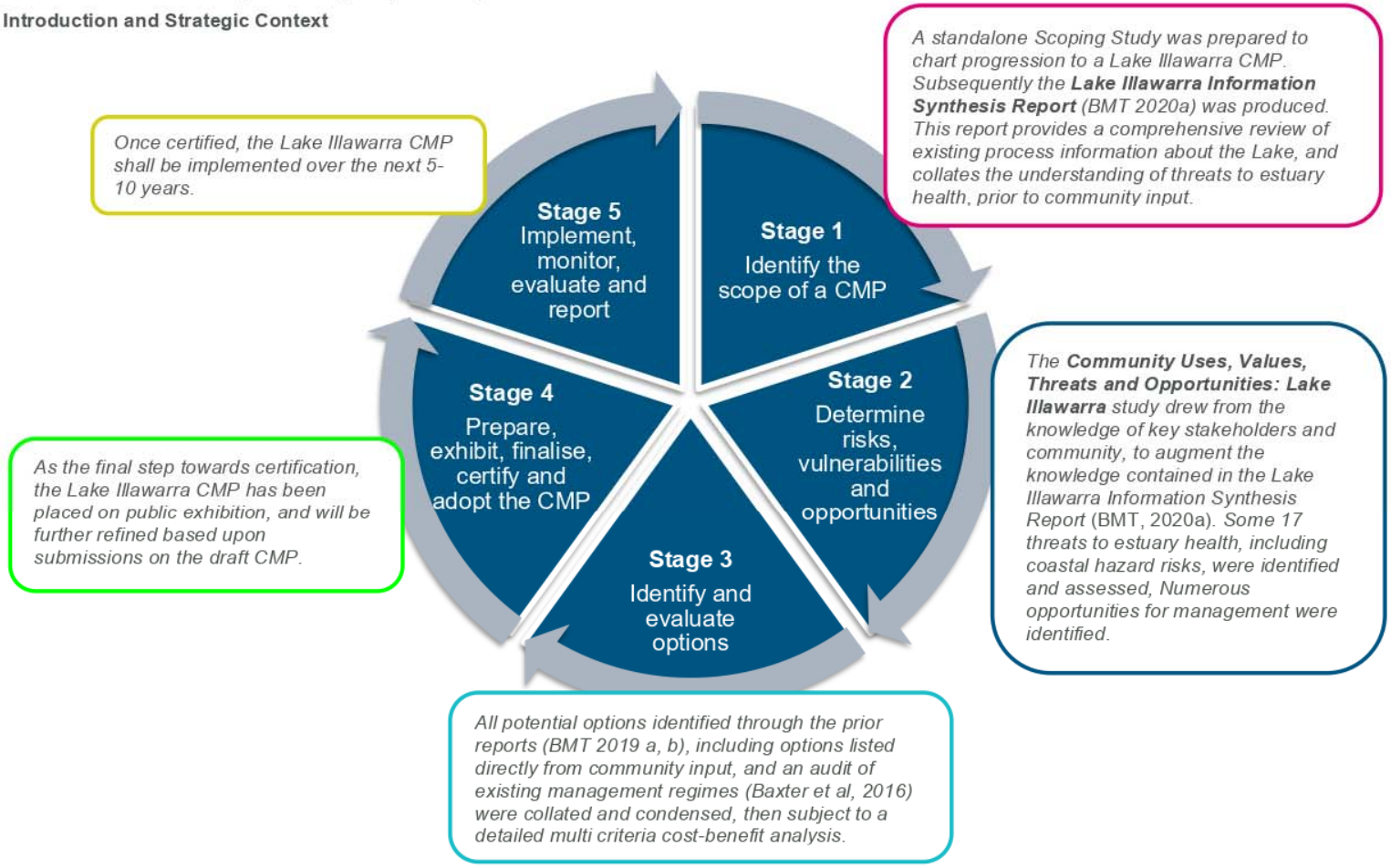


Figure 1-5 Alignment between the 5 Stage Process for CMPs and Lake Illawarra CMP and companion documents

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

Currently there is no mapping of the coastal vulnerability area in NSW under the CM SEPP, including for Lake Illawarra.

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 adequately 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)

The above existing processes are considered to satisfy the requirement in the CM Act for an emergency action sub-plan to manage coastal vulnerability in Lake Illawarra (i.e. inundation risks arising from catchment rainfall and/or elevated ocean levels during storms). It is considered repetitious and potentially confusing to prepare a second set of emergency actions for coastal inundation risks through this CMP process.

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.

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

Category	Stakeholders
Community Groups	• Aboriginal Knowledge Holders and Traditional Custodians • Land care / coast care/ bushcare groups/ bush restoration teams • 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.

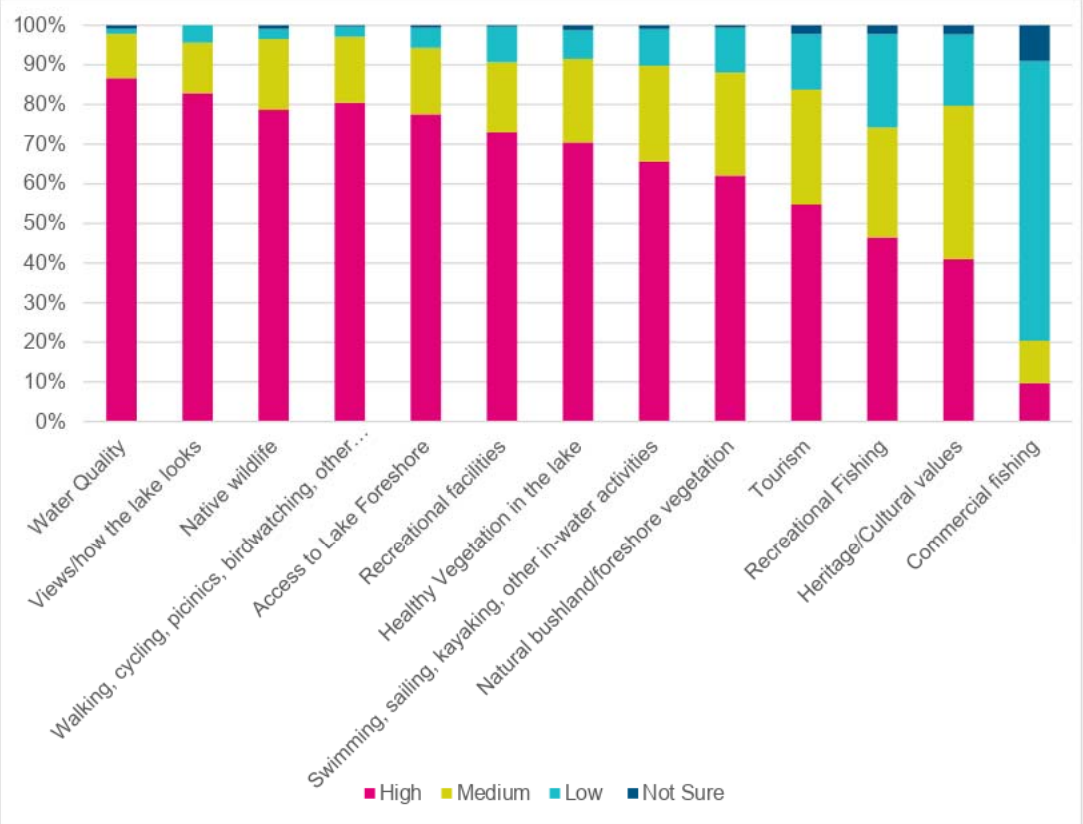


Figure 1-6 Community and Stakeholder Perception of Values Associated with the Lake

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.

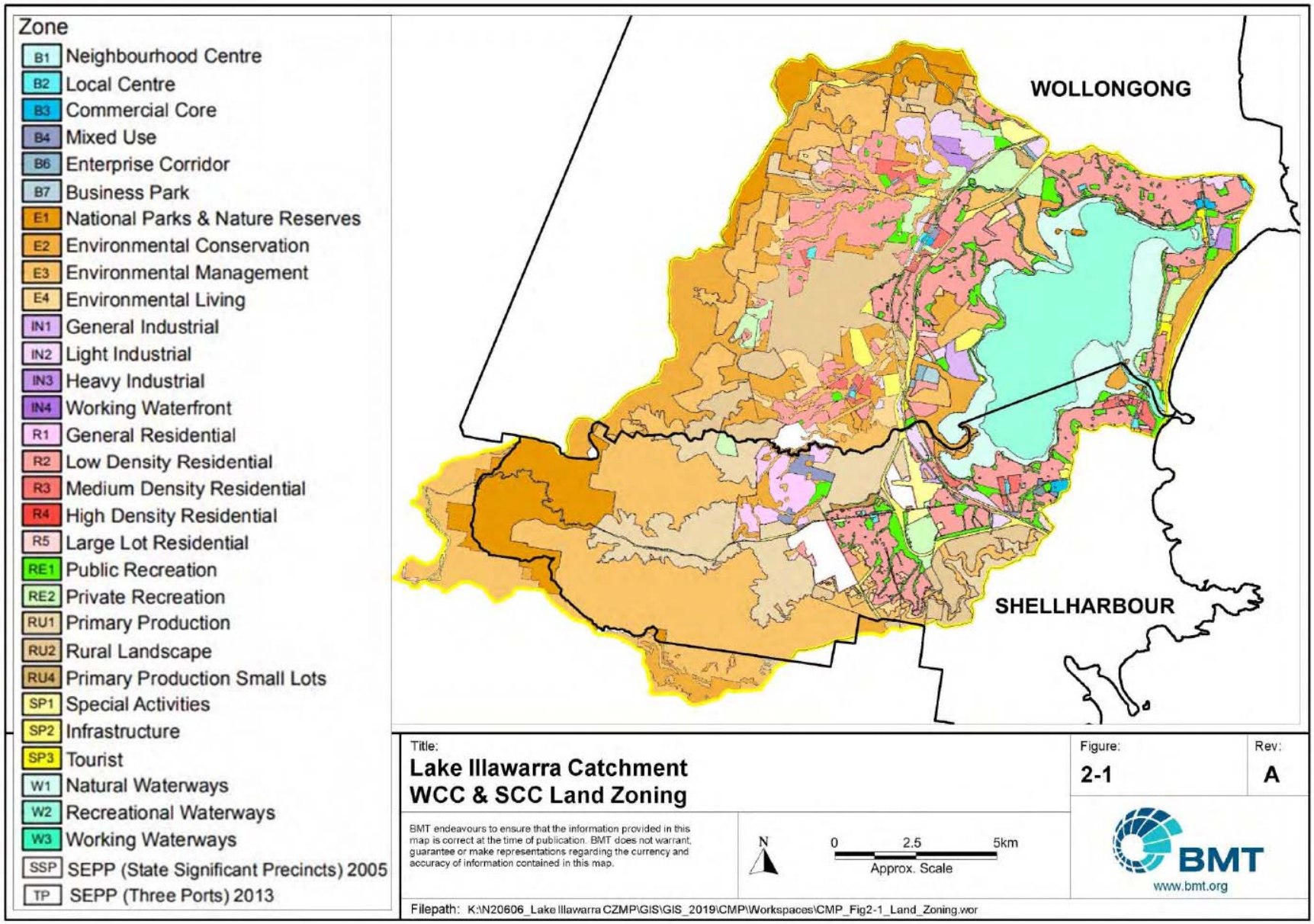
Since the permanent opening of the Lake, there is also evidence that seagrasses on the flood tide delta entering the Lake are being smothered by sand (e.g. see Wiecek et al., 2016). Seagrass is also being lost in other areas due to increased flow velocities and scour, most notably, along the channel 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
Rev:
A
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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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. Conversely, other mechanisms of the Councils and State Government exist to develop and promote tourism opportunities, and are therefore not replicated by this CMP.

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 supports 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.

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 actions (EC1 is now focused on long term management, and EC3 now expanded to cover emergency works and incorporating dredging from former action EC3).

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).

The current 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		

Strategy Implementation 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
	• 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.

Strategy Implementation Plan

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.

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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 Report* (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.

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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	• Windang Town Centre Plan has been revised to reflect appropriate CMP actions and objectives • 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	WCC has allocated $25,000 to developing the Windang Town Centre Plan Refer also to the Illawarra-Shoalhaven Regional Plan WCC are working on a new Land Dedication Principles Policy, Shell Harbour are considering a similar one.

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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.

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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.

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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 Options to Manage Erosion and Accretion Changes in the Entrance Channel and Implement Management Solutions** 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, and implement preferred management options taking into account any built, environmental and cultural heritage issues. 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. *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: ($460,000, 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. • Implement actions to address foreshore erosion, channel scour and accretion: $5-10M. • Implement longer term action to constrain flow and control tidal increases: $15-25M.	WCC, SCC, DPIE –Crown Lands, DPIE – Coasts & Estuaries, TfNSW Supporting: DPI Fisheries	Year 1: Finalise management options study Year 1-3: Prepare detailed design, assessment and approvals for more immediate actions Year 1-5: Implement more immediate actions to manage erosion / accretion Year 1-3: Longer term management option study, design and assessment Year 5-10: Implement preferred longer term option to manage ongoing tidal velocity / prism increase	• Study of issues and potential manage-ment responses for the entrance channel is completed. • Preferred actions are implemented. • Preferred actions are monitored as being effective and environment ally sensitive.	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 is 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 replacing failed protection with rock revetments 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.	$10 M to replace failed revetments on northern foreshore east of bridge (based on past WCC expenditure). $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 prior to commencement of actions from EC1.	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.

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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 (such as completed through EC1). 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 Action 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

Strategy Implementation Plan

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.

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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 what type of environmental assessment will be required and likelihood of approval. 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. • A cost-benefit analysis which includes full lifecycle management considerations.	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 a Business Case, Environmental Assessment and Cost Benefit Analysis	If the investigations 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.	Year5 -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.

Strategy Implementation Plan

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)

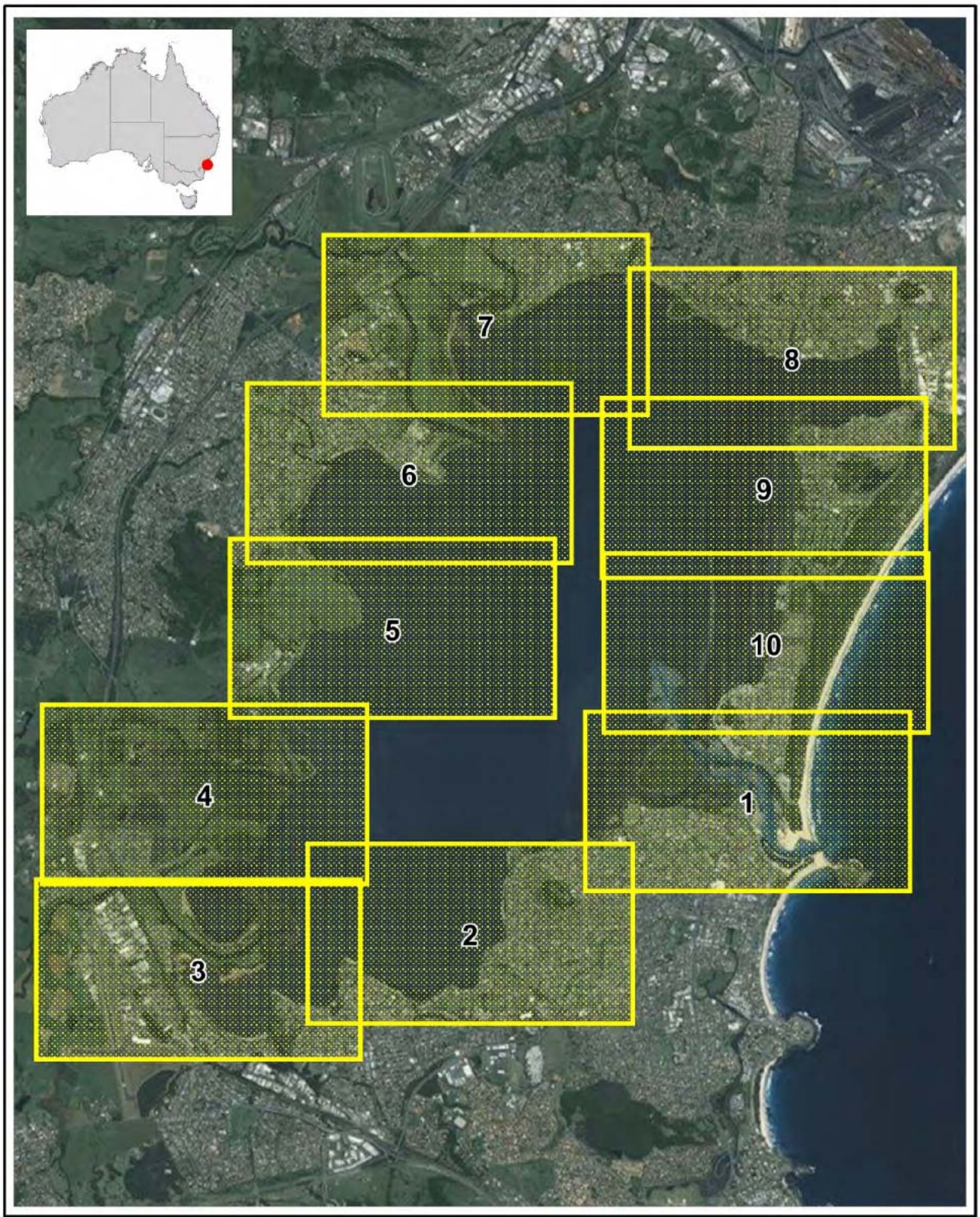
Action ID	Action Details	Locations (see Action Maps also)	Indicative Cost *(subject to available funding)*	Responsibility, Supporting Organisations / Programs	Time-frame *(subject to available funding and resources)*	Performance Measure	Further Information / References
MF1	**Develop and implement a fauna 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**

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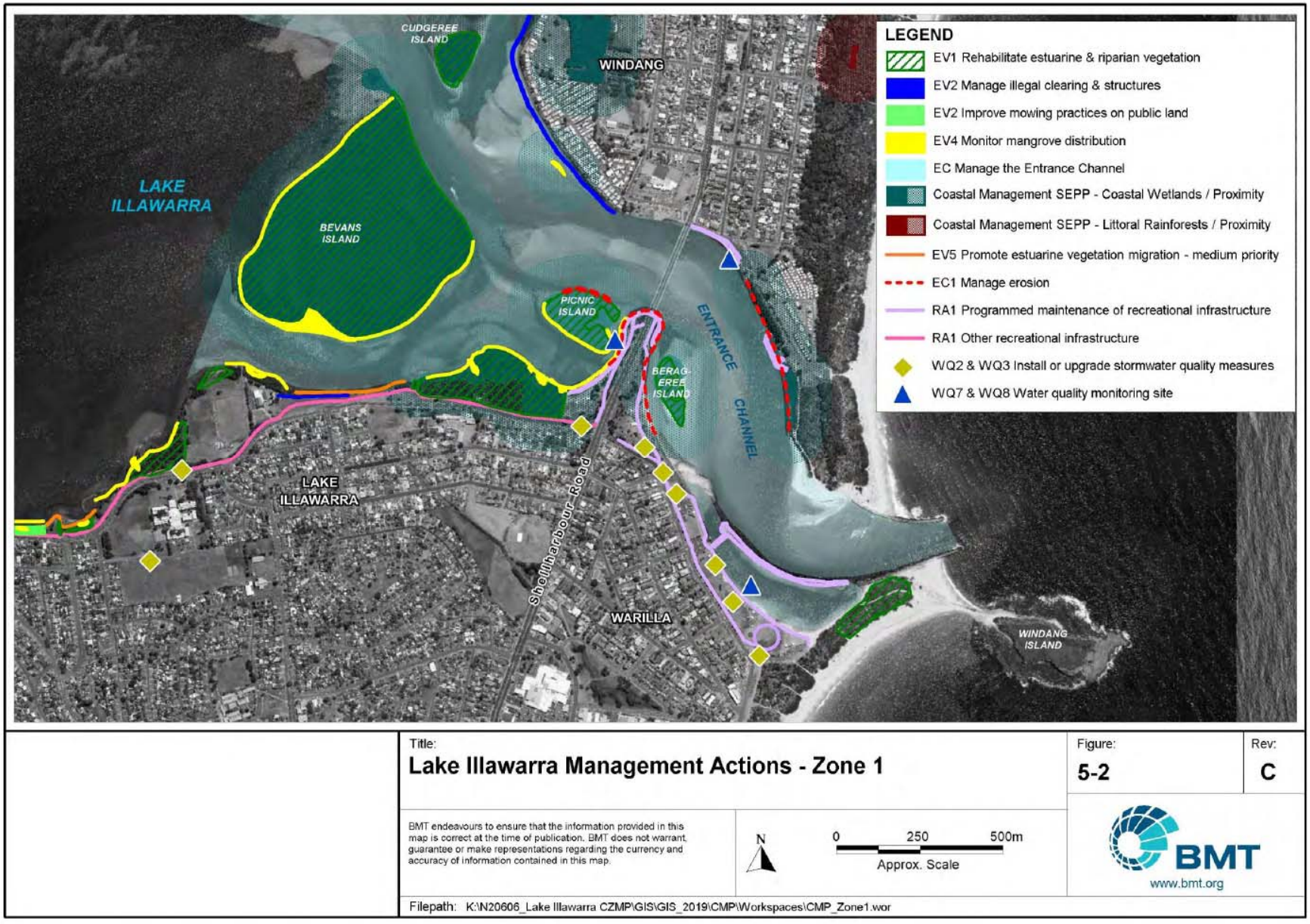
CUDGEREE ISLAND
WINDANG
LAKE ILLAWARRA
BEVANS ISLAND
PICNIC ISLAND
ENTRANCE CHANNEL
BERAGEREE ISLAND
LAKE ILLAWARRA
Shellharbour Road
WARILLA
WINDANG ISLAND
LEGEND
EV1 Rehabilitate estuarine & riparian vegetation
EV2 Manage illegal clearing & structures
EV2 Improve mowing practices on public land
EV4 Monitor mangrove distribution
EC Manage the Entrance Channel
Coastal Management SEPP - Coastal Wetlands / Proximity
Coastal Management SEPP - Littoral Rainforests / Proximity
EV5 Promote estuarine vegetation migration - medium priority
EC1 Manage erosion
RA1 Programmed maintenance of recreational infrastructure
RA1 Other recreational infrastructure
WQ2 & WQ3 Install or upgrade stormwater quality measures
WQ7 & WQ8 Water quality monitoring site
Title:
Lake Illawarra Management Actions - Zone 1
Figure:
5-2
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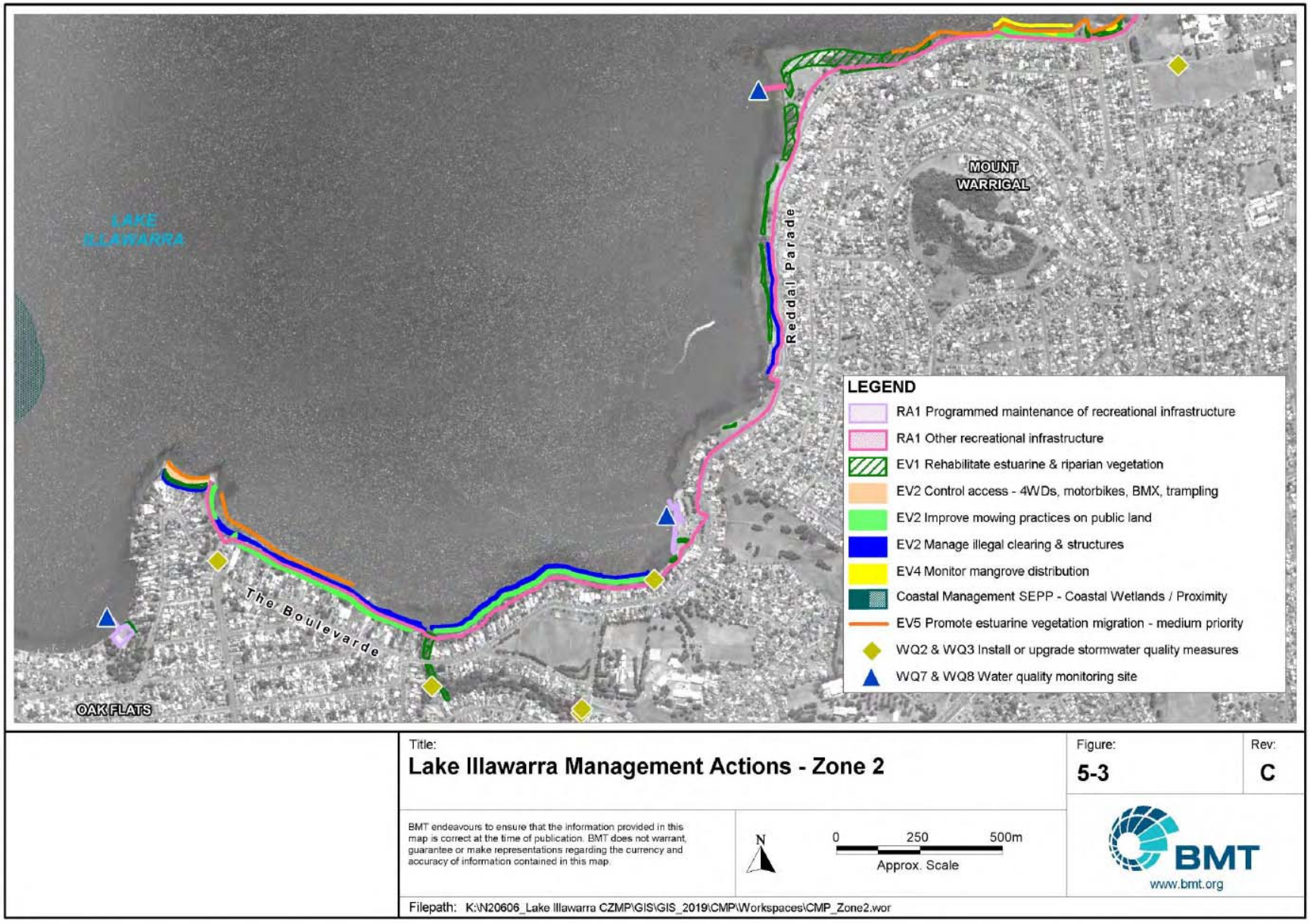
LAKE ILLAWARRA
MOUNT WARRIGAL
Reddall Parade
The Boulevarde
OAK FLATS
LEGEND
RA1 Programmed maintenance of recreational infrastructure
RA1 Other recreational infrastructure
EV1 Rehabilitate estuarine & riparian vegetation
EV2 Control access - 4WDs, motorbikes, BMX, trampling
EV2 Improve mowing practices on public land
EV2 Manage illegal clearing & structures
EV4 Monitor mangrove distribution
Coastal Management SEPP - Coastal Wetlands / Proximity
EV5 Promote estuarine vegetation migration - medium priority
WQ2 & WQ3 Install or upgrade stormwater quality measures
WQ7 & WQ8 Water quality monitoring site
Title:
Lake Illawarra Management Actions - Zone 2
Figure:
5-3
Rev:
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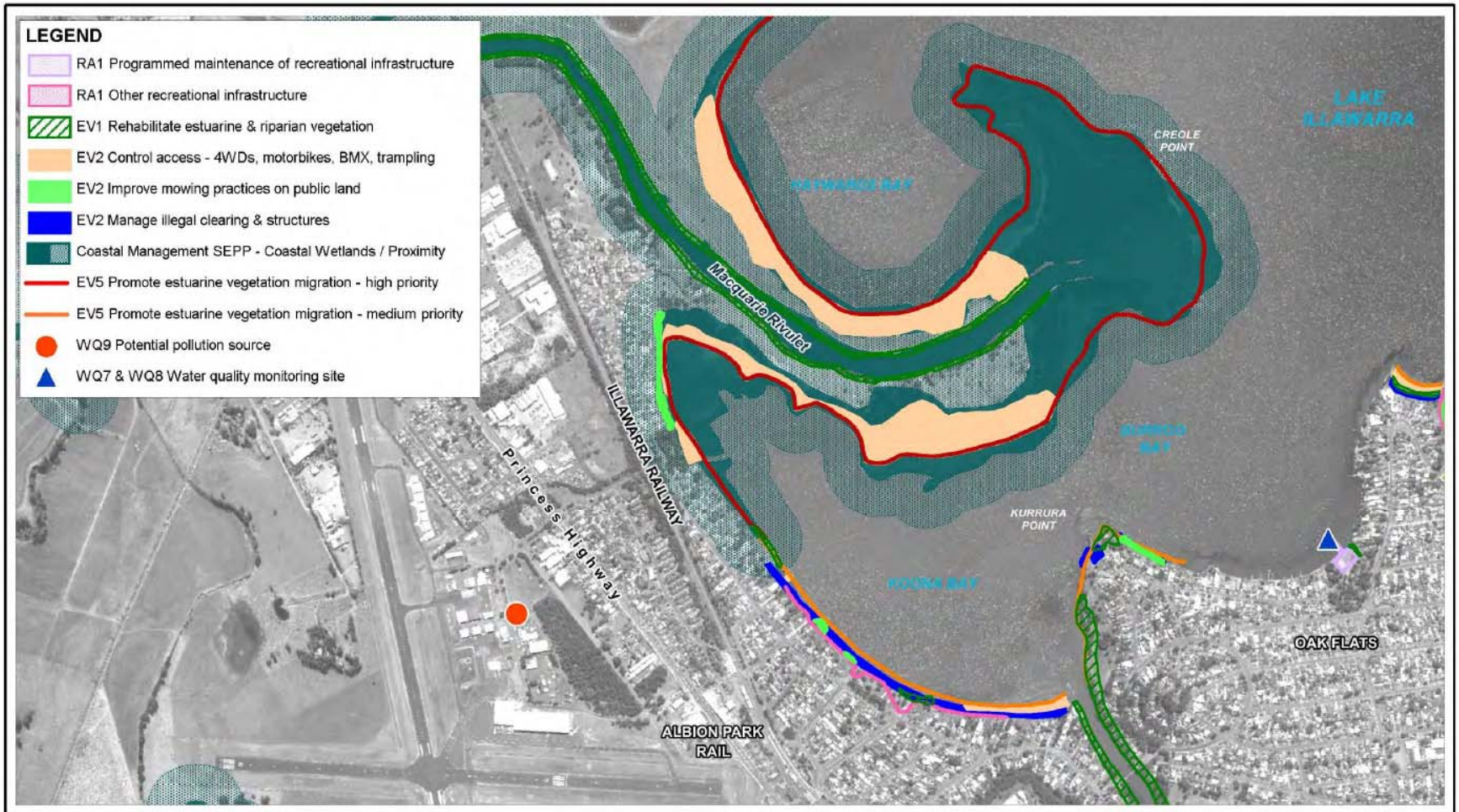

Title:
Lake Illawarra Management Actions - Zone 3

Figure: **5-4**

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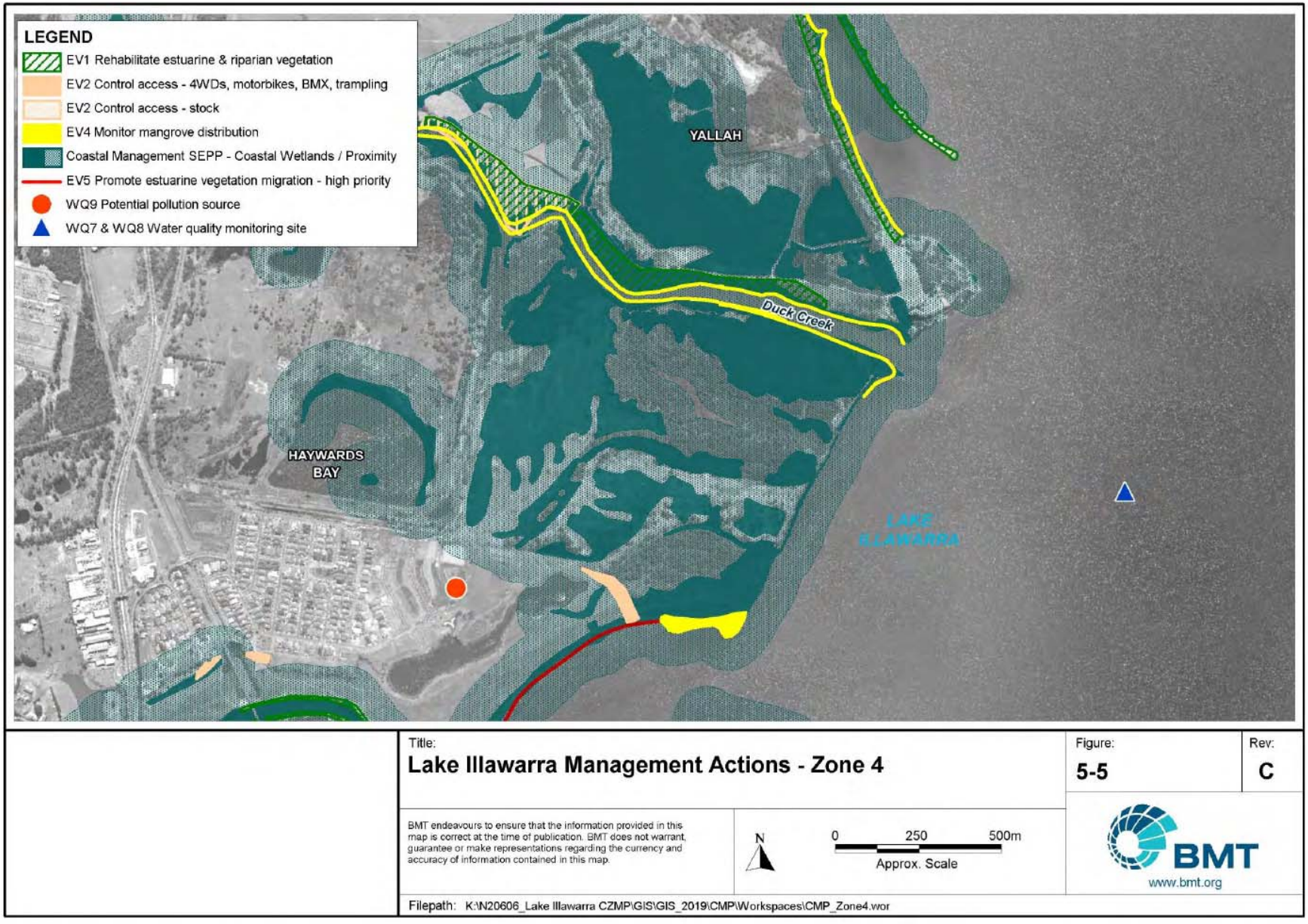
LEGEND
EV1 Rehabilitate estuarine & riparian vegetation
EV2 Control access - 4WDs, motorbikes, BMX, trampling
EV2 Control access - stock
EV4 Monitor mangrove distribution
Coastal Management SEPP - Coastal Wetlands / Proximity
EV5 Promote estuarine vegetation migration - high priority
WQ9 Potential pollution source
WQ7 & WQ8 Water quality monitoring site
YALLAH
Duck Creek
HAYWARDS BAY
LAKE ILLAWARRA
Title:
Lake Illawarra Management Actions - Zone 4
Figure:
5-5
Rev:
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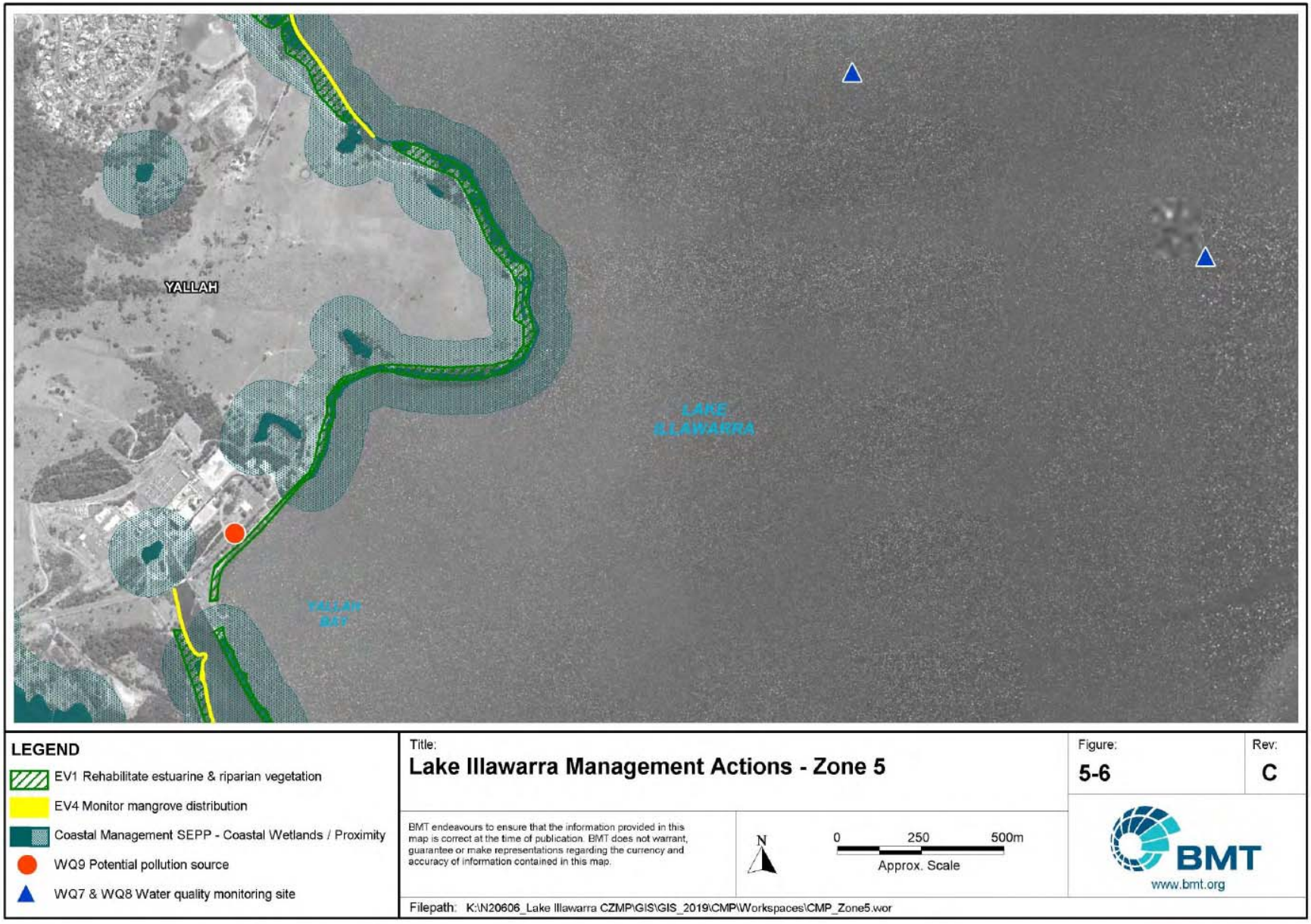
YALLAH
LAKE ILLAWARRA
YALLAH BAY
LEGEND
EV1 Rehabilitate estuarine & riparian vegetation
EV4 Monitor mangrove distribution
Coastal Management SEPP - Coastal Wetlands / Proximity
WQ9 Potential pollution source
WQ7 & WQ8 Water quality monitoring site
Title:
Lake Illawarra Management Actions - Zone 5
Figure:
5-6
Rev:
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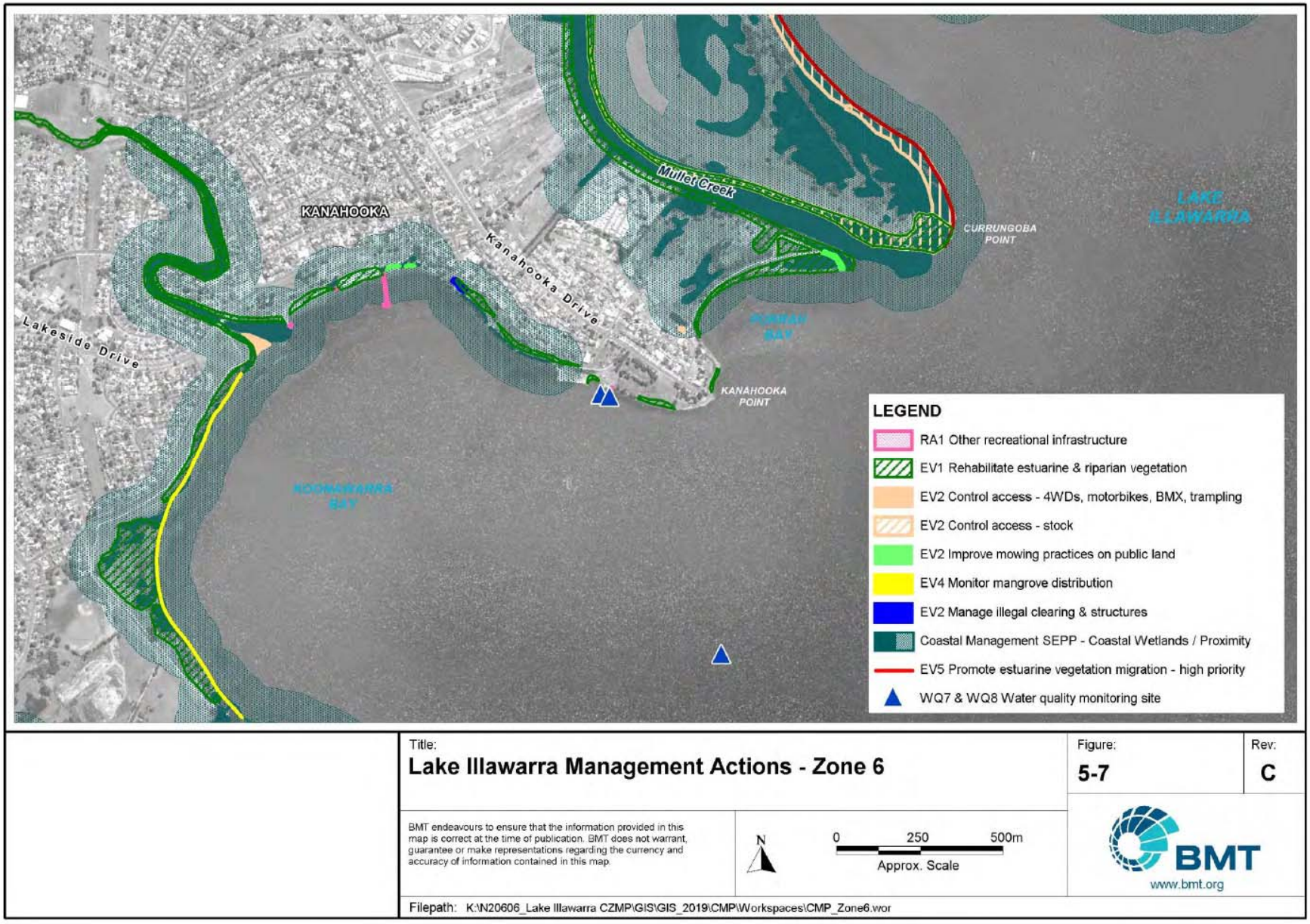

Title:
Lake Illawarra Management Actions - Zone 6

Figure: **5-7**

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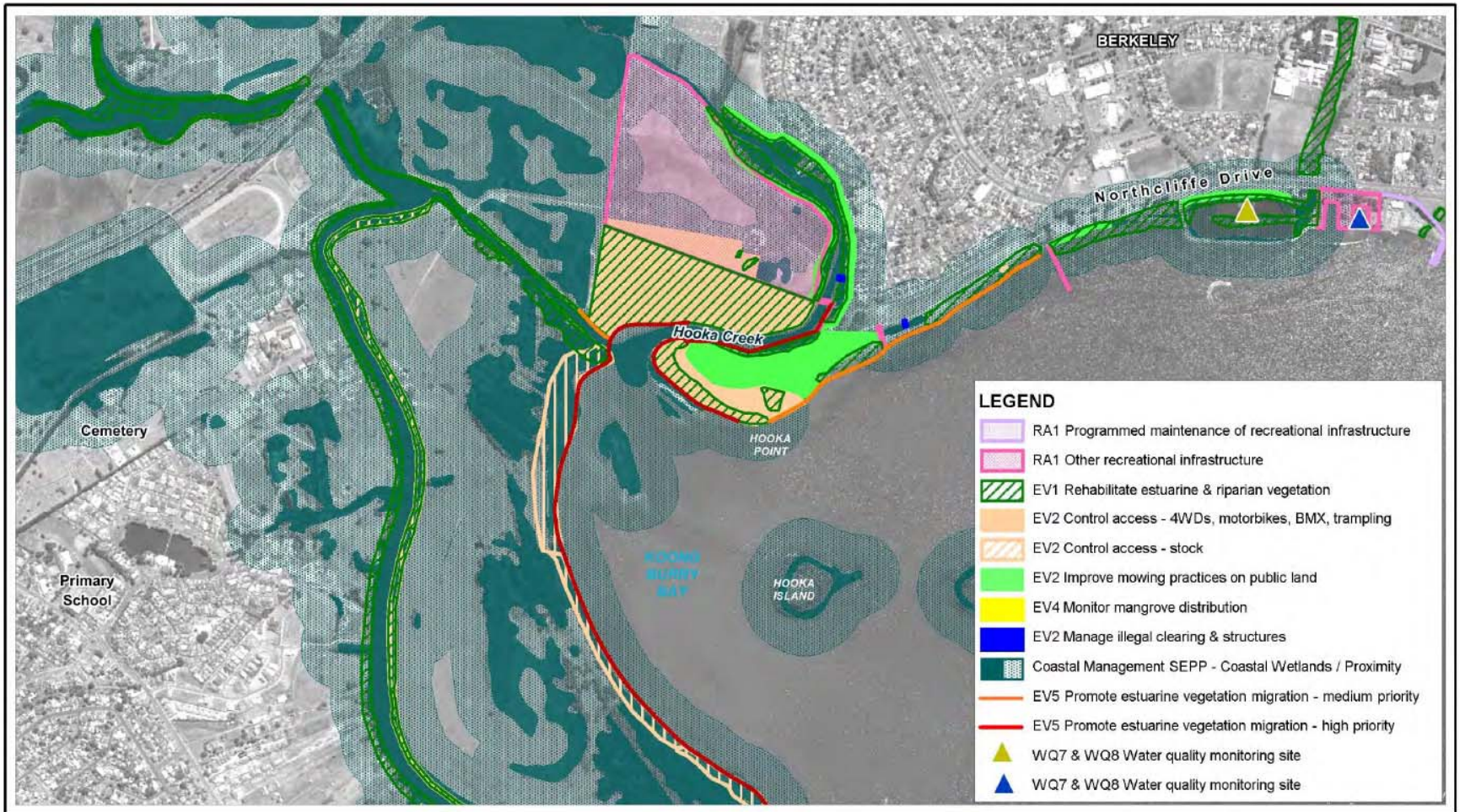

Title:
Lake Illawarra Management Actions - Zone 7

Figure: **5-8**

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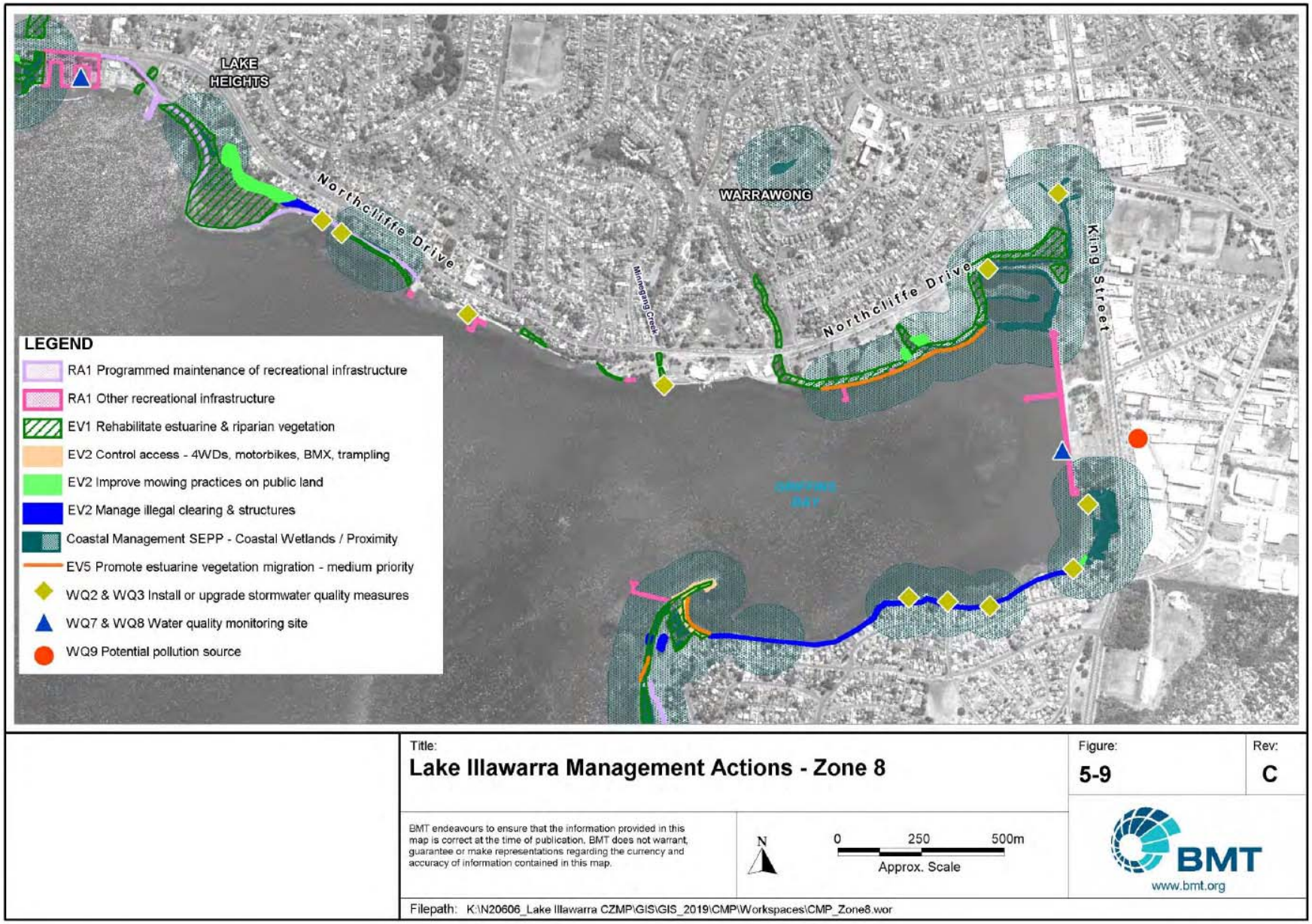
LAKE HEIGHTS
Northcliffe Drive
WARRAWONG
Minnegang Creek
Northcliffe Drive
King Street
LEGEND
RA1 Programmed maintenance of recreational infrastructure
RA1 Other recreational infrastructure
EV1 Rehabilitate estuarine & riparian vegetation
EV2 Control access - 4WDs, motorbikes, BMX, trampling
EV2 Improve mowing practices on public land
EV2 Manage illegal clearing & structures
Coastal Management SEPP - Coastal Wetlands / Proximity
EV5 Promote estuarine vegetation migration - medium priority
WQ2 & WQ3 Install or upgrade stormwater quality measures
WQ7 & WQ8 Water quality monitoring site
WQ9 Potential pollution source
Title:
Lake Illawarra Management Actions - Zone 8
Figure:
5-9
Rev:
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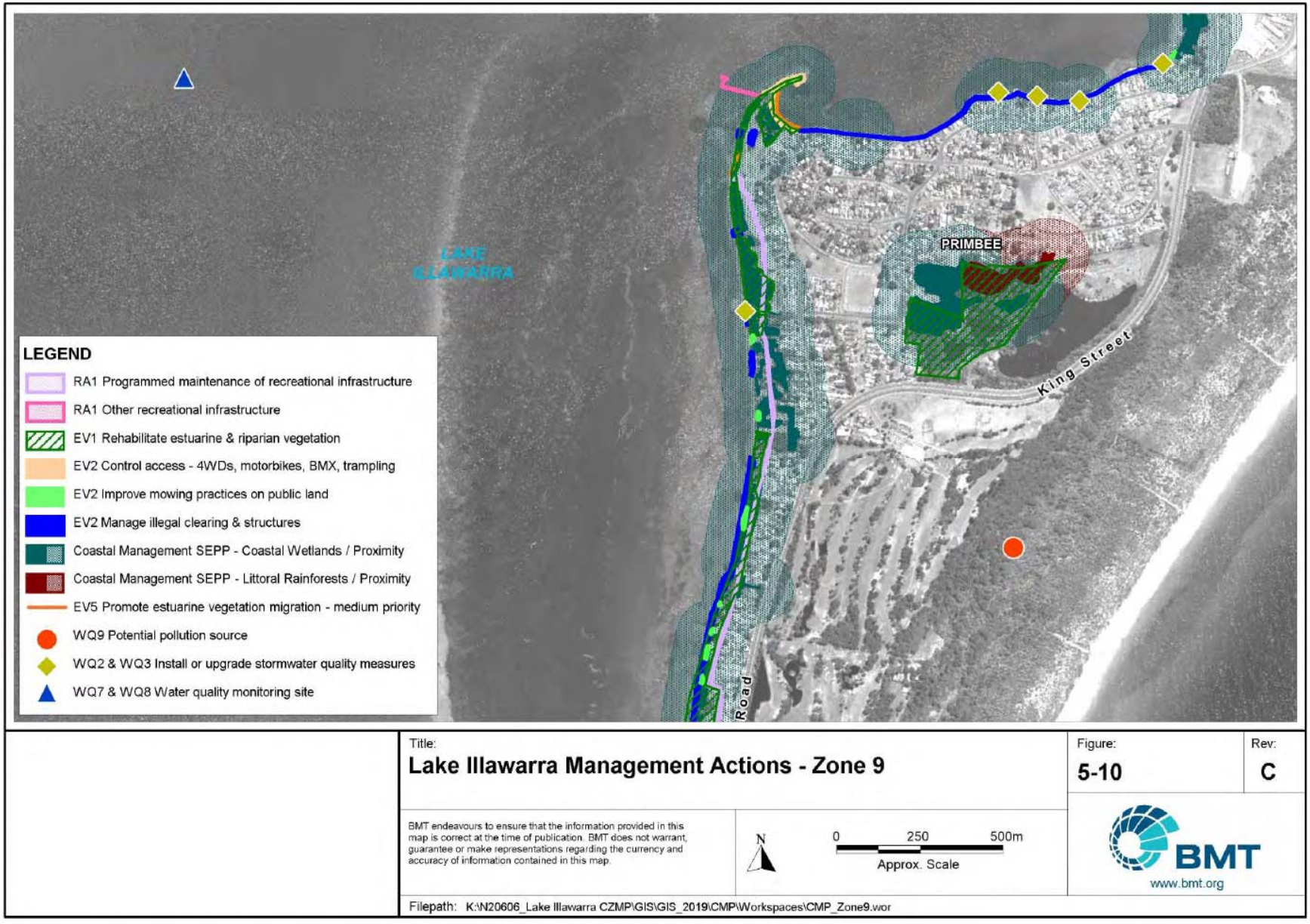
LAKE ILLAWARRA
PRIMBEE
King Street
Road
LEGEND
RA1 Programmed maintenance of recreational infrastructure
RA1 Other recreational infrastructure
EV1 Rehabilitate estuarine & riparian vegetation
EV2 Control access - 4WDs, motorbikes, BMX, trampling
EV2 Improve mowing practices on public land
EV2 Manage illegal clearing & structures
Coastal Management SEPP - Coastal Wetlands / Proximity
Coastal Management SEPP - Littoral Rainforests / Proximity
EV5 Promote estuarine vegetation migration - medium priority
WQ9 Potential pollution source
WQ2 & WQ3 Install or upgrade stormwater quality measures
WQ7 & WQ8 Water quality monitoring site
Title:
Lake Illawarra Management Actions - Zone 9
Figure:
5-10
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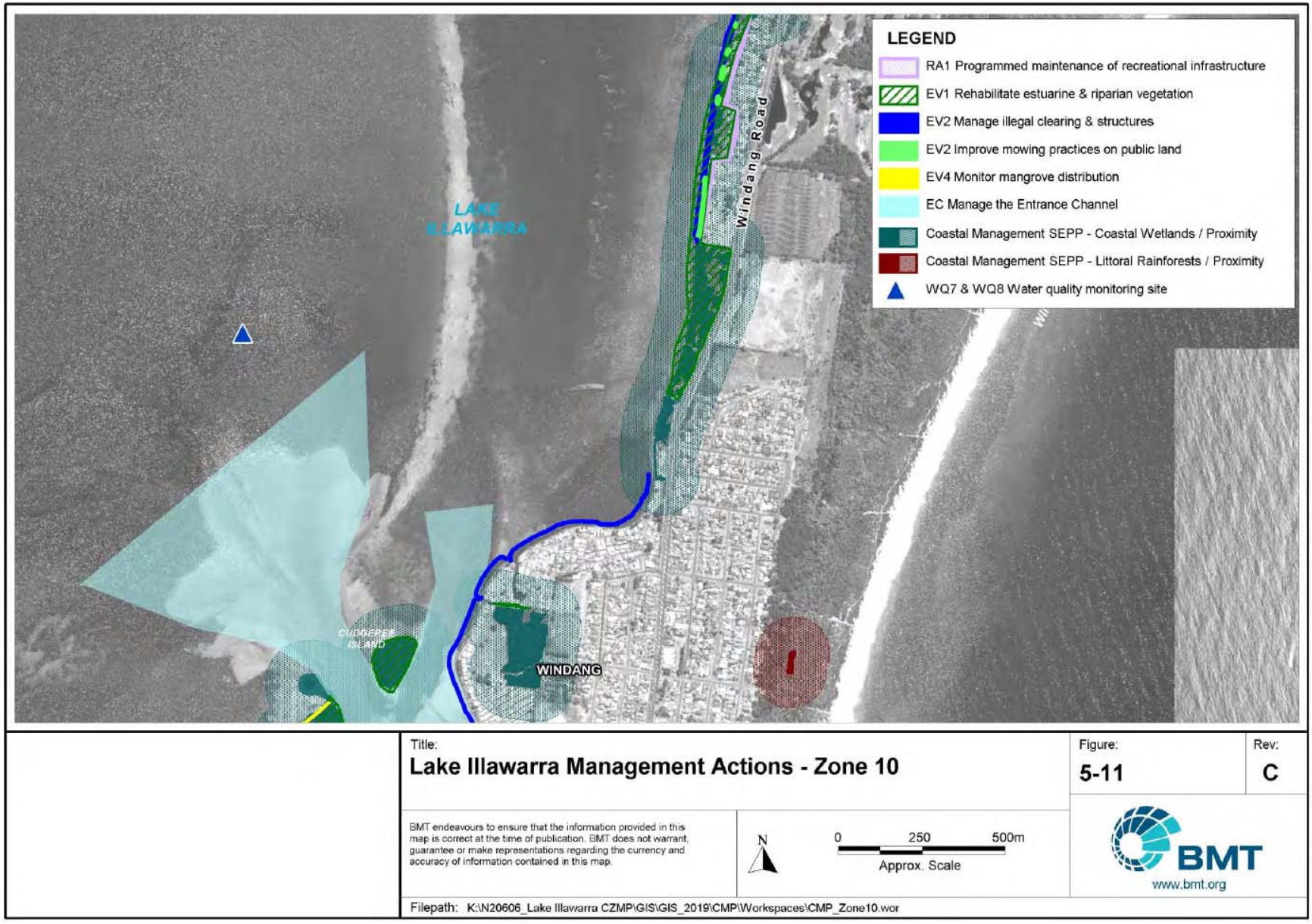
LEGEND
RA1 Programmed maintenance of recreational infrastructure
EV1 Rehabilitate estuarine & riparian vegetation
EV2 Manage illegal clearing & structures
EV2 Improve mowing practices on public land
EV4 Monitor mangrove distribution
EC Manage the Entrance Channel
Coastal Management SEPP - Coastal Wetlands / Proximity
Coastal Management SEPP - Littoral Rainforests / Proximity
WQ7 & WQ8 Water quality monitoring site
LAKE ILLAWARRA
Windang Road
CUDGERES ISLAND
WINDANG
Title:
Lake Illawarra Management Actions - Zone 10
Figure:
5-11
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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 $45,300,000 over 10 years, plus an estimated $27,500,000 for long term entrance channel works following action EC1. Existing staff resources in the Councils and 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, $5,193,000 is required in Year 1 to implement specified actions. A forecast $31,037,000 is estimated across Year 2 to 5 (inclusive), with a final $36,570,000 required over Years 6 to 10 for the plan. 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.

Table 6-1 Cost Estimates for CMP Implementation 94

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	**$72,800,000**		**$5,193,000**	**$31,037,000**	**$36,570,000**		
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.

Table 6-1 Cost Estimates for CMP Implementation

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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 = $460,000 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. Estimated total of $5-10 million for implementation of short term options (assumed $7.5 M for this costing spreadsheet). Estimated total of $15-25 million for implementation of long term solution (assumed $20 M for this costing spreadsheet).	Year 1 to 10	$760,000	$6,950,000	$21,750,000	• 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 $12.65 million for: $150,000 for one dredging campaign + $10 M to replace 250 m of failing revetment on northern foreshore + $2.5M to place rocks below Windang Bridge piers for stability.	Year 1 to 5	$1,000,000	$11,650,000		• 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.

Table 6-1 Cost Estimates for CMP Implementation 96

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.

Table 6-1 Cost Estimates for CMP Implementation 97

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 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.

Once the plan 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 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). 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. 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 ($) 104

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.	$760,000	$6,950,000				$21,750,000					$29,460,000
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.	$1,000,000	$11,650,000									$12,650,000
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	

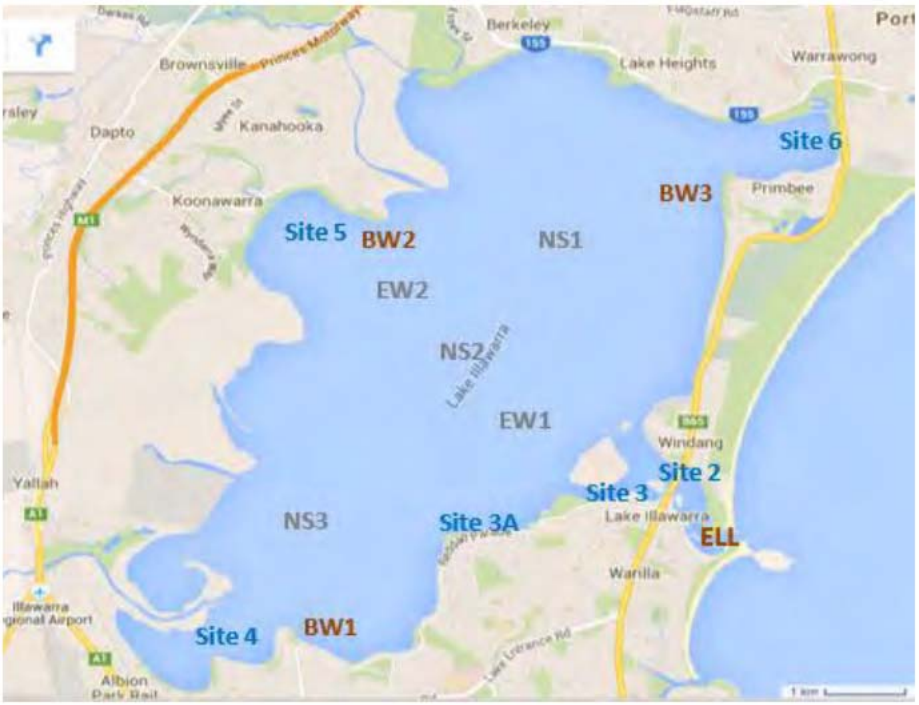
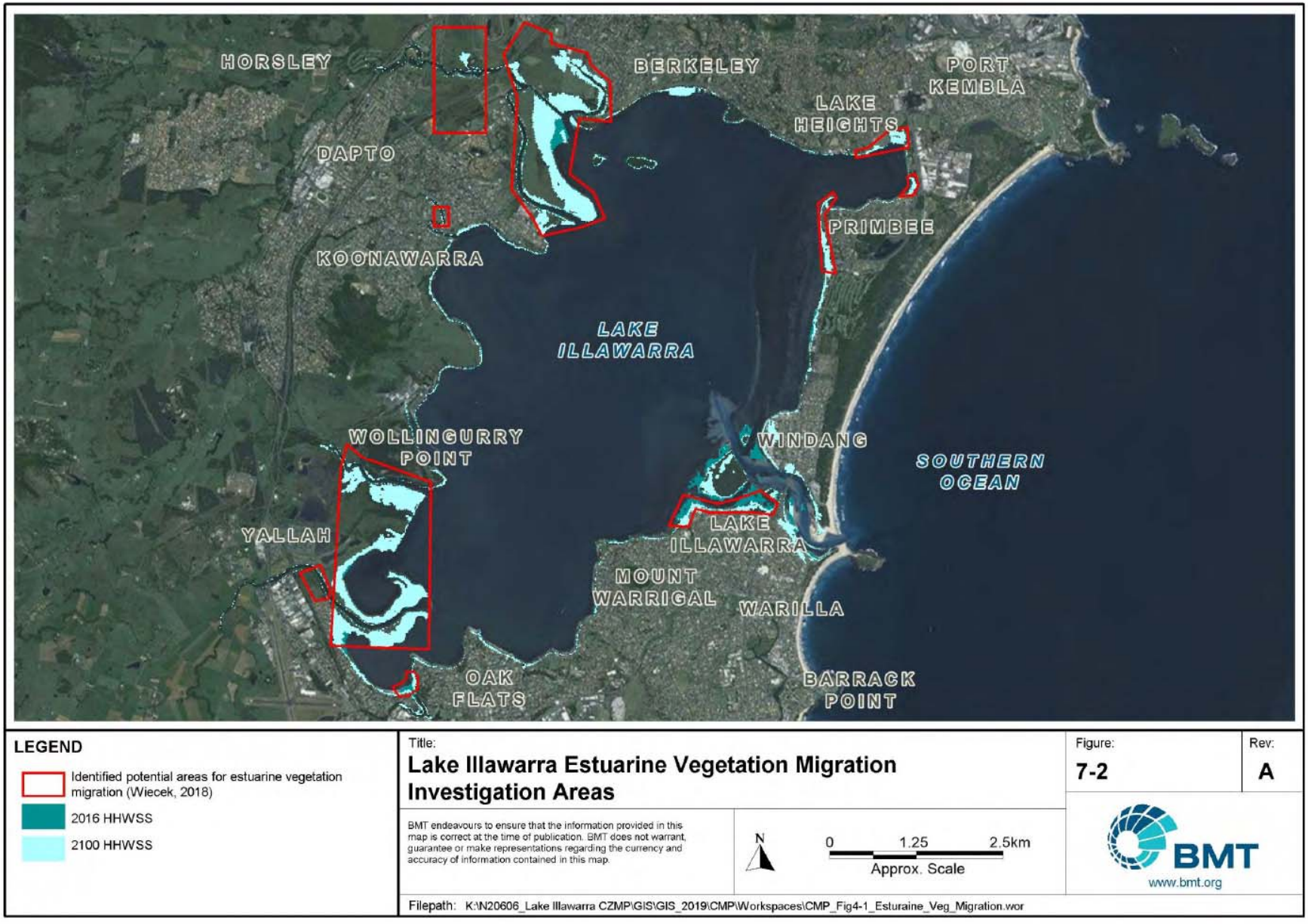


Figure 7-1 Location of Sampling Sites for the Water Quality and Estuary Health Monitoring Program and for Recreational Use

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.


HORSLEY
BERKELEY
PORT KEMBLA
LAKE HEIGHTS
DAPTO
PRIMBEE
KOONAWARRA
LAKE ILLAWARRA
WOLLINGURRY POINT
WINDANG
SOUTHERN OCEAN
YALLAH
LAKE ILLAWARRA
MOUNT WARRIGAL
WARILLA
OAK FLATS
BARRACK POINT
LEGEND
Identified potential areas for estuarine vegetation migration (Wiecek, 2018)
2016 HHWSS
2100 HHWSS
Title:
Lake Illawarra Estuarine Vegetation Migration Investigation Areas
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.
N
0
1.25
2.5km
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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 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 both the current Guidelines for preparing coastal zone management plans (OEH, 2013) and 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	The management objectives for the coastal management areas are re-iterated in the coastal

Section 14 of the Coastal Management Act 2016 defines the preparation of CMPs as follows	How this CMP addresses these requirements
management areas covered by the program, and	strategy statement and objectives of this CMP, see Section 1.5.
(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 plan 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.

Table A-3 Essential Elements for a Coastal Management Program Relevant to Preparation of the CMP

Draft essential elements associated with Section 14 of the CM Act: Preparation of CMPs		How this CMP addresses these elements
4)	A CMP is to be prepared using the staged process set out in the manual (see Figure 3 of the Introduction for an outline of the five stages), noting that all stages do not need to be completed if they are not relevant.	The Lake Illawarra CMP has been prepared in accordance with both the current Guidelines for preparing coastal zone management plans (OEH, 2013) and the NSW Coastal Management Manual (OEH, 2018) that was current at the time of this CMP's preparation.
5)	All councils commencing the preparation or review of a CMP must complete Stage 1 (scoping study) of the process. At the conclusion of the scoping study, councils should take the opportunity to seek advice from DPIE and the Coastal Council on which of the subsequent stages are applicable.	A scoping study has been compiled by WCC and SCC. Advice from DPIE was sought, and stated that the Lake Illawarra project could be completed as a CMP. Prior stages of preparing this CMP included the *Lake Illawarra Information Synthesis Report* (BMT, 2020a) detailing current knowledge of the Lake's processes, and a *Community Uses, Values, Threats and Opportunities Lake Illawarra* report (BMT, 2020b). Stakeholder and community engagement was undertaken throughout the studies.
6)	Councils should take the opportunity to seek advice from DPIE and the Coastal Council at the conclusion of key stages of the CMP process.	At each stage of the preparation of this CMP, DPIE has been involved in the review of documents and provided guidance on subsequent stages of the CMP.
7)	Councils should submit a draft CMP that is consistent with the requirements of the Manual to DPIE. After exhibition of the draft CMP, Councils should provide a copy of the final draft of the CMP to DPIE for review before it is submitted to the Minister for certification. The Minister may refer the CMP to the Coastal Council for advice before the Minister considers certification.	This is the process to be followed for the Lake Illawarra CMP certification.
8)	Councils should identify priority objectives for their coastal management areas. When identifying objectives for a CMP that includes one or more coastal management areas, councils must be consistent with the objectives for coastal management areas as required by the draft CM Bill and proposed CM SEPP. The objectives must align with the objectives identified by the local community in developing the Community Strategic Plan.	The objectives for this CMP have been aligned with the objectives specified in the CM Act, see Section 1.5

Draft essential elements associated with Section 14 of the CM Act: Preparation of CMPs	How this CMP addresses these elements
9) Councils should identify the priority management issues and opportunities affecting the coastal zone where the program is to apply. These may relate to: a) coastal processes and environmental values b) social and cultural values c) Aboriginal values d) coastal economies e) coastal development and land use planning f) current and future risk from coastal hazards and climate change g) the ambulatory nature of the shoreline h) integration and coordination of planning and management i) resilience of coastal assets j) public participation, and k) marine estate. l) What outcomes are required from a CMP process	A comprehensive assessment of coastal management issues and opportunities has been undertaken as part of this Lake Illawarra CMP. Coastal management issues and opportunities affecting the Lake were identified primarily through the *Lake Illawarra Information Synthesis Report* (BMT, 2020a) and the *Community Uses, Values, Threats and Opportunities Lake Illawarra* Report (BMT, 2020b) completed as a precursor to this CMP.
10) The CMP should be developed after the preparation of:	
a) a Coastal Strategy Statement. The Strategy Statement sets the long-term strategy for the integrated and coordinated management of the coastal zone with a focus on achieving the objectives of the draft CM Bill. This includes identification of: i. coastal management issues and opportunities ii. strategies and actions linked to coastal management areas covered by the CMP, including a map of proposed actions	A coastal strategy statement for this CMP has been prepared in Section 1.5.
b) specific trigger points or indicators of when a strategic approach will no longer be viable. This should be based on thresholds for intolerable and unacceptable risk at that locality.	Strategy "Prepare for Inundation Risks" in Section 4.8 provides the strategies through which trigger points and indicators will be implemented. A tidal inundation risk assessment was conducted for this CMP, and combined with the existing coastal inundation risk registers already completed for the Lake provides detail regarding the specific assets (including natural assets) at risk over specified future timeframes.

Draft essential elements associated with Section 14 of the CM Act: Preparation of CMPs	How this CMP addresses these elements
identification of coastal management actions that are council's responsibility, and are consistent with the Strategy Statement. After certification and adoption of the CMP, the final council actions will be incorporated in council's IP&R framework and land use planning system	The Strategy Implementation Plan in Chapter 4 identifies the responsibilities for implementation (lead and support), including the local councils (WCC and SCC) and other public authorities. The implementation tables also provide details to enable the actions to be implemented through both councils IP&R Frameworks.
c) identification of coastal management actions that are consistent with the Strategy Statement and require coordination with adjoining councils or are the responsibility of public authorities. The draft CMP should include an acknowledged acceptance of these management actions where they include public authority responsibilities and/or coordination with adjoining councils prior to certification by the Minister, and	The Strategy Implementation Plan in Chapter 4 identifies the responsibilities for implementation (lead and support), including the local councils (WCC and SCC) and other public authorities. 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. Acknowledged acceptance of their roles shall be provided prior to certification of the CMP.
d) a business plan to demonstrate viable funding of proposed actions.	A business plan for the CMP is provided in Chapter 6.
A CMP should include: e) a summary statement of the overall CMP Strategy that demonstrates how the CMP provides an integrated and sustainable program of coastal management in line with the Objectives in the CM Bill, any regional objectives and the objectives of the council	Overarching summary statements regarding the purpose, intent, context and objectives of this CMP are delivered in Chapter 1.
f) coastal management actions to be implemented by council through IP&R and land use planning processes which are consistent with the Strategy Statement and are the responsibility of the council, in addition the actions to be implemented by adjoining councils (where relevant) and public authorities	The Strategy Implementation Plan in Chapter 4 identifies the responsibilities for implementation (lead and support), including the local councils (WCC and SCC) and other public authorities. The implementation tables also provide details to enable the actions to be implemented through both councils IP&R Frameworks. The implementation tables also indicate those actions to be implemented through changes to the LEP, DCP or other planning documents.
g) a brief summary of the business plan outlining the key components of the funding strategy for the proposed actions	A business plan for the CMP is provided in Chapter 6.
h) where the CMP is being prepared for a coastal vulnerability area, a coastal erosion emergency action sub-plan, and	As outlined in detail in Section 1.7.3, present day inundation risks are currently effectively managed through the Flood Risk Emergency Management process.

Draft essential elements associated with Section 14 of the CM Act: Preparation of CMPs	How this CMP addresses these elements
i) a map (or maps) showing linked actions for each relevant coastal management area along the coast. These maps should include adjoining local council areas where cross boundary management needs to be consistent or fully aligned to address issues such as regional scale sediment compartment processes, or where an estuary or wetland and its catchment straddles a council boundary.	Management Strategy Maps for the Lake are provided in Chapter 5.
Supporting documentation for a CMP will include: j) a detailed Coastal Strategy Statement which provides context and objectives and establishes council's strategic direction(s) for the coast	A coastal strategy statement for this CMP has been prepared in Section 1.5.
k) a detailed business plan for implementation of the CM, and	A business plan for the CMP is provided in Chapter 6.
l) a listing of all detailed reports relied on in the preparation of the CMP, and a statement as to how to publicly access any of the listed documents.	Previous studies supporting this CMP are discussed in Section 1.9, and includes the *Lake Illawarra Information Synthesis Report* (BMT, 2020a), and a *Community Uses, Values, Threats and Opportunities Lake Illawarra* report (BMT, 2020b).
11) Councils should identify management actions which reduce risks and contribute to achieving the proposed strategic direction for each coastal management unit. Proposed management responses should reduce consequences or reduce the likelihood of a hazard or threat affecting a vulnerable asset (natural, social or economic). These responses should: a) reflect the vulnerability and opportunities in the coastal management program area b) reduce risks affecting coastal ecosystems and biodiversity and identify opportunities to improve the health of coastal ecosystems c) identify opportunities to improve coastal use, access and amenity, and coast dependent economic activity, and d) be identified in consultation with stakeholders.	The process for identifying management actions is outlined in Chapter 3, with the strategies assessment outcomes documented in the *Lake Illawarra CMP Management Actions Assessment* (BMT, 2020c). The process included a detailed multicriteria cost benefit analysis of the options, including assessment of the options direct influence on the threats to the Lake, in order to identify suitable actions for the CMP.

Draft essential elements associated with Section 14 of the CM Act: Preparation of CMPs	How this CMP addresses these elements
12) Councils must develop a business plan that demonstrates viable funding mechanisms for proposed coastal management actions that are consistent with their IP&R Resourcing Strategy. In the business plan: a) councils should identify and consider the full capital, operational and maintenance costs of potential coastal management actions b) councils should identify the distribution of costs and benefits of potential management actions. The distribution analysis should consider council, agency, directly affected coastal community stakeholders (such as landholders in coastal hazard areas), indirectly affected coastal community stakeholders and the environment, and c) the costs of coastal management actions should be apportioned among beneficiaries, taking into account capacity to pay.	A business plan for the CMP is provided in Chapter 6.
13) If a CMP is prepared to address a coastal vulnerability area, that program should include all parts of the coastal zone that are: a) vulnerable to existing or potential hazards (including extreme events), or b) likely be affected by coastal hazards over a defined planning horizon. c) This could include the waters, beaches, dunes and headlands of the open coast, the waters, shorelines and riparian areas of coastal lakes and the shorelines, and the waters, banks, riparian areas and floodplains of estuaries, as far upstream as the tidal limit.	This CMP sets out the process for defining the coastal vulnerability area for Lake Illawarra, refer to Section 1.3.1.1. Present day inundation risks are currently effectively managed through the Flood Risk Emergency Management process. Coastal inundation for Lake Illawarra was mapped through the course of the Lake Illawarra Floodplain Risk Management Plan (Cardno, 2012), and the Wollongong Coastal Zone Study (Cardno, 2010). A risk assessment was undertaken for coastal inundation in Lake Illawarra, and management strategies developed to address this risk in two key supporting documents to this CMP: • Lake Illawarra Coastal Risk Assessment (BMT WBM, 2013) • Wollongong Coastal Zone Management Plan: Management Study (BMT WBM, 2017). Tidal inundation risks were assessed through a separate hydrodynamic modelling exercise by Kumbier et al (2019) and then a risk assessment was conducted specifically for tidal inundation as documented in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b). Management actions to address future storm and tidal inundation risks are specified in Section 4.8, as well as through other specific actions in the plan.

Draft essential elements associated with Section 14 of the CM Act: Preparation of CMPs	How this CMP addresses these elements
14) The CMP should be developed to consider potential very large, low probability events and ongoing long-term changes, at timeframes up to, and if appropriate, beyond 100 years. Different levels of hazard and risk assessment detail are appropriate for long-term (less certain) and near-term hazards and risks.	The timeframes and events considered through the course of this CMP are outlined in Section 1.6.
15) The area covered by the CMP should allow for uncertainty about the impacts of future coastal hazards and potential threats to coastal biodiversity and socio-economic assets and their condition.	This CMP sets out the process for defining the coastal vulnerability area for Lake Illawarra, refer to Section 1.3.1.1. The threat and risk assessment conducted for this CMP in the *Community Uses, Values, Threats and Opportunities: Lake Illawarra* study (BMT, 2020b) also considered future changes that will affect the future level of risk from identified threats.
16) The planning horizons should consider potential coastal change, including a) climate change, including relative sea level rise b) population growth, and c) projected use of coastal land for infrastructure, housing, commercial, recreational and conservation purposes.	The intended timeframe for implementation of this CMP is 10 years, as consistent with the CM Act. Actions are typically focussed on achieving improvements over this timeframe, with some actions incidentally having a longer term effect. With respect to coastal inundation risks, a longer planning horizon has been considered when developing actions.
17) A CMP may also include opportunities to enhance biodiversity (within coastal wetlands and littoral rainforest areas and coastal environment areas) and social and economic assets and conditions in the coastal zone including enhanced public access and enjoyment of the coastal amenity. The area covered by the CMP should include appropriate buffer areas to allow for uncertainty and change over time.	The Lake Illawarra CMP is focussed on actions to remediate the threats to the Lake and to enhance its environmental and thereby social and economic values. A number of actions in the CMP directly intend to enhance biodiversity, and social and economic assets of the Lake. The area covered by this CMP (as outlined in Section 1.3) provides an appropriate buffer to allow for uncertainty and change over time.

BMT has a proven record in addressing today's engineering and environmental issues.

Our dedication to developing innovative approaches and solutions enhances our ability to meet our client's most challenging needs.

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Lake Illawarra Coastal Management Program (CMP) 2020–2030

Snapshot

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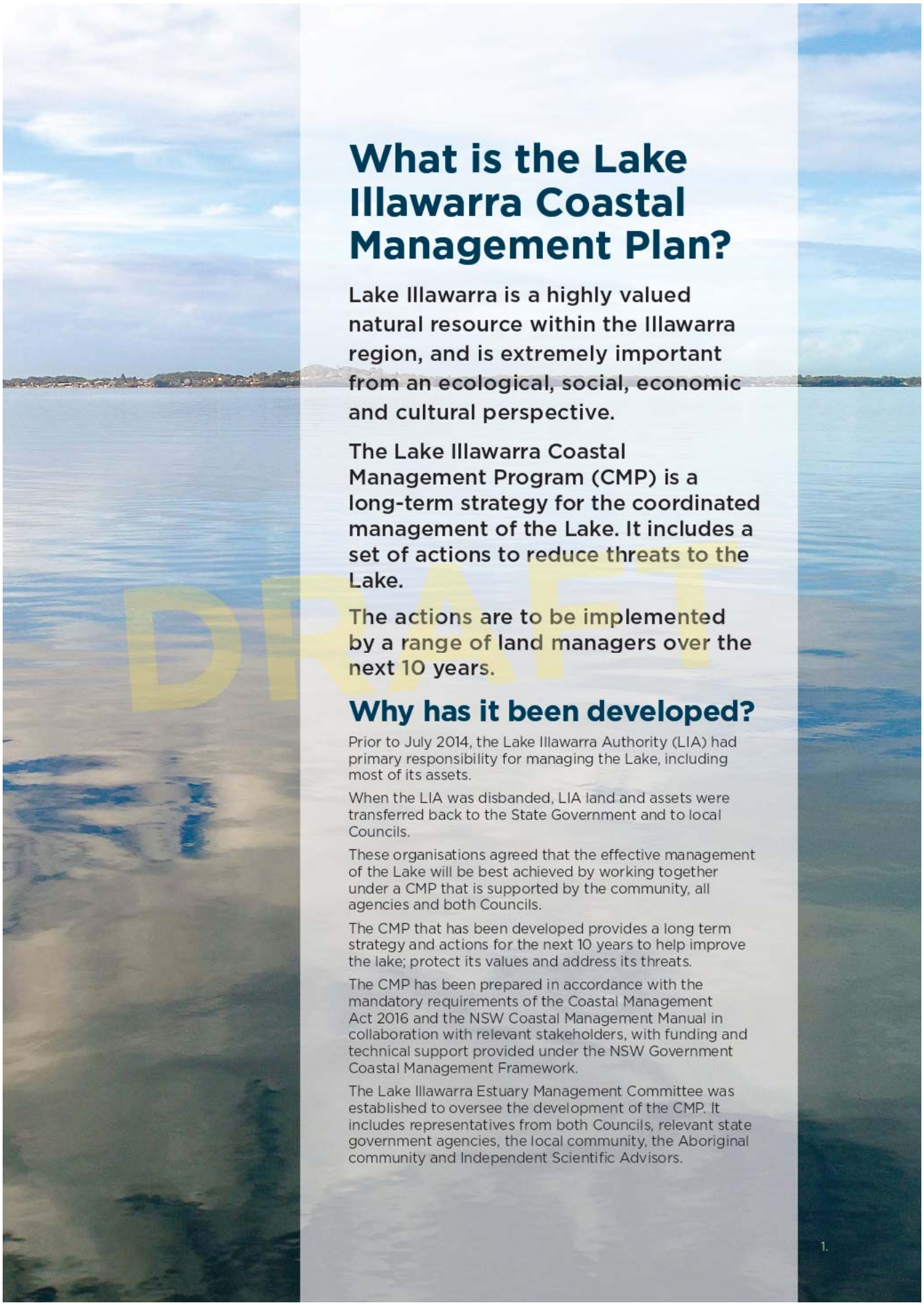
wollongong
city of innovation

Shellharbour
CITY COUNCIL



What is the Lake Illawarra Coastal Management Plan?

Lake Illawarra is a highly valued natural resource within the Illawarra region, and is extremely important from an ecological, social, economic and cultural perspective.

The Lake Illawarra Coastal Management Program (CMP) is a long-term strategy for the coordinated management of the Lake. It includes a set of actions to reduce threats to the Lake.

The actions are to be implemented by a range of land managers over the next 10 years.

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Why has it been developed?

Prior to July 2014, the Lake Illawarra Authority (LIA) had primary responsibility for managing the Lake, including most of its assets.

When the LIA was disbanded, LIA land and assets were transferred back to the State Government and to local Councils.

These organisations agreed that the effective management of the Lake will be best achieved by working together under a CMP that is supported by the community, all agencies and both Councils.

The CMP that has been developed provides a long term strategy and actions for the next 10 years to help improve the lake; protect its values and address its threats.

The CMP has been prepared in accordance with the mandatory requirements of the Coastal Management Act 2016 and the NSW Coastal Management Manual in collaboration with relevant stakeholders, with funding and technical support provided under the NSW Government Coastal Management Framework.

The Lake Illawarra Estuary Management Committee was established to oversee the development of the CMP. It includes representatives from both Councils, relevant state government agencies, the local community, the Aboriginal community and Independent Scientific Advisors.

What area does the Lake Illawarra Coastal Management Plan cover?

This CMP covers the entire Lake Illawarra water body and the catchment that affects it, including:

- upstream to the tidal limits of the tributaries to the Lake (namely Macquarie Rivulet, Mullet, Brooks, Duck and Horsley Creeks);
- downstream to the entrance channel (including the entrance training works and extending out to the ebb tide delta);
- all foreshore areas of the Lake, and
- the wider catchment area when catchment activities pose a threat to the Lake itself (e.g. poor stormwater quality affecting the water quality within the Lake).

The CMP applies to parts of both the Shellharbour and Wollongong City Council local government areas.

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What are the values and uses of Lake Illawarra?

Lake Illawarra's values and uses were identified through surveys and discussions with the community, as well as using existing scientific information for the Lake, as follows:

- Water quality
- Views / how the Lake looks
- Native wildlife
- Access to Lake foreshore
- Recreational facilities
- Healthy vegetation in the lake
- Foreshore activities
- In-water activities
- Natural bushland / foreshore vegetation
- Tourism
- Recreational fishing
- Heritage / cultural Values
- Commercial fishing

What are the threats to Lake Illawarra?

Threats relate to activities that directly or indirectly impact the values and uses that have been identified for the Lake.

Threats to Lake Illawarra were initially identified through community and stakeholder consultation. The identified threats were then assessed using a risk rating that considered the frequency of the threats, and the environmental, social and/or economic consequences of the threats both now and into the future (beyond 2040).

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Identified Threats to Lake Illawarra	Risk Rating	
	Now	Future
Water pollution	Very High	Very High
Catchment development	Very High	Very High
Changes due to entrance channel opening	Very High	Very High
Loss of estuarine vegetation	High	High
Wetland degradation	High	High
Litter, plastics and marine debris	High	High
Contaminated sediments	High	High
Inappropriate / degraded / insufficient infrastructure	High	High
Loss of tangible and intangible cultural heritage	High	High
Foreshore development encroaching public land	Medium	Very High
Loss of riparian habitat	Medium	Very High
Foreshore and bank erosion	Medium	High
Climate change	Medium	High
Park management practices impacting adjacent natural areas	Medium	Medium
Commercial fishing	Medium	Medium
Inefficient/ Incorrect Lake management	Medium	Medium
Introduced species	Low	Medium

How were actions developed?

The CMP prescribes 39 specific actions under nine management strategies designed to address the threats to the Lake (see table on next page).

These actions have been selected from an audit of the previous management plans for the Lake, recommendations developed during the CMP process, and from community and agency input including a formal exhibition period. Actions were put through a multi-criteria analysis process which examined the ability of the action to mitigate the threat and a cost-benefit assessment to determine feasibility and effectiveness.

How will actions be implemented?

A range of organisations are directly responsible for implementing the CMP, including Wollongong City Council and Shellharbour City Council as well as State Government agencies such as Crown Lands and Property NSW. Each agency has made the commitment to consider the actions in their forward planning and budgeting processes.

For Councils this will be through their yearly Operational Plans and four yearly Delivery Programs.

How will actions be funded?

Wollongong City Council and Shellharbour City Council 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, the existing budgets of the Councils may fund some of the actions, particularly in the CMP's first year until grant funding can be secured.

There is a range of other funding importunities available for all stakeholders to fund the implementation of the CMP including various local, state and federal grant programs.

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Management Actions

Strategy 1: Improve Water Quality (WQ)	
WQ1	Implement a Risk Based Stormwater Management Framework for the Lake Illawarra catchment
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
WQ3	Review and prioritise maintenance and cleaning regime for existing stormwater quality devices
WQ4	Design and implement targeted catchment input monitoring as required for developments resulting in a large-scale change or intensification of land use
WQ5	Reduce sediment load to the Lake by improving compliance with erosion & sediment controls for development sites.
WQ6	Reduce the impact of sewer overflows
WQ7	Implement water quality monitoring programs for estuary health, recreational use and physico-chemical and bacteriological indicators in the Lake and its catchment
WQ8	Improve litter management
WQ9	Investigate and manage potential pollution sources including contaminated sites that contribute to poor water quality in the lake
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
PM2	Provide ongoing coordinated management of the Lake, which will require ongoing support for existing staff resources
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
PM4	Establish a Lake Illawarra Asset Management Working Group that provides coordination services for agencies that manage assets around the Lake Illawarra foreshore
Strategy 3: Manage the Entrance Channel (EC)	
EC1	Investigate options to manage erosion and accretion changes in the entrance channel and implement management solutions
EC2	Undertake small scale works (e.g. beach scraping, re-shaping etc) to maintain swimming areas
EC3	Undertake emergency works or small scale no-regrets actions as required to mitigate known risks to property and public safety
EC4	Monitor changes to the entrance channel
EC5	Monitor and maintain existing entrance channel infrastructure, with any works to be informed by EC1-EC3 and EC4
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
EV2	Undertake targeted action to control damage to foreshore vegetation, including seagrasses
EV3	Prepare and deliver an information program for the Lake Catchment
EV4	Prepare and implement an estuarine macrophyte mapping and monitoring program
EV5	Develop and implement a program to enhance opportunities for estuarine vegetation migration
Strategy 5: Maintain and Improve Recreational Amenity (RA)	
RA1	Manage foreshore and waterway recreational infrastructure
RA2	Construct new sections of shared pathway to complete the pathway linkage around the Lake
RA3	Investigate the opportunities of public access along the foreshore and amend the acquisition layers of the relevant Council Local Environmental Plans if applicable
RA4	Build on the Tourism opportunities for Lake Illawarra
RA5	Conduct small scale dredging to improve public recreational outcomes and to improve the functionality of stormwater outlet infrastructure
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
Strategy 6: Protect and Promote Cultural Heritage (CH)	
CH1	Protect and promote cultural heritage in and around the Lake and its catchment
Strategy 7: Manage Foreshore and Bank Erosion (FB)	
FB1	Undertake a bank condition assessment and determine and implement erosion control measures
FB2	Implement Environmentally Friendly Seawall Guidelines or similar for new and upgraded foreshore protection works
FB3	Undertake a bathymetric survey of the entire Lake and tributaries up to the tidal limit
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
IR2	Prepare a whole of Lake Foreshore Adaptation Plan for public (community and environmental) lands
IR3	Incorporate tidal inundation mapping into strategic land use planning documents
IR4	Undertake water level and condition monitoring for all lake inundation events
IR5	Investigate novel solutions to manage inundation risks to assets such as stormwater, sewer, and water; cycleways, roads and bridges, etc
Strategy 9: Protect and Manage Key Fauna (MF)	
MF1	Develop and implement a fauna management program including shorebirds, fish and other fauna

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How will we know the CMP is making a difference?

A mandatory CMP reporting and review process will track implementation and performance against the performance measures set for each action.

In addition, each Council produces an Annual Report documenting their progress in implementing their Delivery Program and Operational Plan, and so, CMP actions will be evaluated and reported on a yearly basis through this process.

One of the actions in the CMP is an estuary health monitoring program to identify if the implementation of actions is leading to improvements. The CMP will be reviewed in 5 – 10 years with these results in mind.

Working together

Ongoing stakeholder collaboration is critical to ensure the coordinated management of the Lake and its surrounds into the future and effective implementation of the CMP. A stakeholder reference group is proposed to provide advice to the Councils and agencies on the CMP implementation.

Community members can provide support by attending events, joining in education activities, and even volunteering for Bushcare or Landcare. Education activities and other events aim to celebrate the things we value about the Lake, and to change any potentially damaging behaviours in and around the Lake. Community involvement is vital to support these activities, and the success of the CMP.

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This snapshot is a summary of the Lake Illawarra Coastal Management Program (CMP). The CMP was written by consultants BMT, overseen by a Project Management Team consisting of staff from Wollongong and Shellharbour City Councils and DPIE - Coasts & Estuaries. It's development was funded by State and Local Governments and overseen and supported by The Lake Illawarra Estuary Management Committee.

Projected Costings CMP Implementation – Wollongong City Council

Improve Water Quality (WQ)

Action	Total projected cost for CMP across 10 years	Change from previous draft	Total projected cost to WCC		
			Year 1 (20/21)	Years 2-5 (2021-2025)	Years 6-10 (2025-2030)
WQ1 Implement Risk Based Stormwater Management Framework	$245,000	+$25,000 years 2-3	$0	$30,000	$0
WQ2 Upgrade existing stormwater quality measures	$1,565,000	No change	$16,667	$260,000	$633,333
WQ3 Review and prioritise maintenance for existing stormwater devices	$2,455,000	No change	$16,667	$530,000	$850,000
WQ4 Design and implement targeted monitoring for large scale developments	$25,000	No change	$16,667	$0	$0
WQ5 Improve compliance with erosion and sediment controls for development	$1,600,000	+$1,280,000 (additional $160,000 p.a. years 3-10)	$80,000	$320,000	$400,000
WQ6 Reduce the impact of sewer overflows	$0	No change	$0	$0	$0
WQ7 Undertake estuary water quality monitoring	$1,300,000	+$20,000 over 10 years	$86,000	$346,666	$433,000
WQ8 Improve litter management (New)	$530,000	+$530,000 over 10 years	$27,500	$110,000	$137,500
WQ9 Manage potential pollution sources including contaminated sites	$240,000	+$180,000 over years 2-5	$0	$160,000	$0
TOTAL	**$7,960,000**	**+$2,035,000**	**$244,167**	**$1,756,000**	**$2,453,833**

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Improve Planning and Management Arrangements for the Lake (PM)

Action	Total projected cost for CMP across 10 years	Change from previous draft	Total projected cost to WCC		
			Year 1 (20/21)	Years 2-5 (2021-2025)	Years 6-10 (2025-2030)
PM1 Integrate key objectives of the CMP into planning and policy documents	$100,000	No change	$0	$50,000	$0
PM2 Provide ongoing coordinated management of the lake	$2,500,000	No change	$166,666	$666,667	$833,333
PM3 Develop a community engagement and participation strategy	$980,000	No change	$53,333	$266,667	$333,333
PM4 Establish a Lake Illawarra Asset Management Working Group	$70,000	No change	$16,667	$13,333	$16,667
TOTAL	**$3,650,000**	**No change**	**$236,666**	**$996,667**	**$1,183,333**

Protect and Promote Cultural Heritage (CH)

Action	Total projected cost for CMP across 10 years	Change from previous draft	Total projected cost to WCC		
			Year 1 (20/21)	Years 2-5 (2021-2025)	Years 6-10 (2025-2030)
CH1 Protect and promote cultural heritage in and around the lake and its catchment	$1,200,000	No change	$80,000	$320,000	$400,000
TOTAL	**$1,200,000**	**No change**	**$80,000**	**$320,000**	**$400,000**

Protect and Manage Key Fauna (MF)

Action	Total projected cost for CMP across 10 years	Change from previous draft	Total projected cost to WCC		
			Year 1 (20/21)	Years 2-5 (2021-2025)	Years 6-10 (2025-2030)
MF1 Develop and implement fauna management program	$125,000	No change	$13,333	$40,000	$30,000
TOTAL	**$125,000**	**No change**	**$13,333**	**$40,000**	**$30,000**

Manage the Entrance Channel (EC)

Action	Total projected cost for CMP across 10 years	Change from previous draft	Total projected cost to WCC		
			Year 1 (20/21)	Years 2-5 (2021-2025)	Years 6-10 (2025-2030)
EC1 Investigate entrance channel processes and implement solutions	$29,460,000	+$23,250,000	$760,000	$3,000,000	$10,000,000
EC2 Undertake small scale works (eg beach scraping) to maintain swimming areas.	$300,000	No change	$0	$0	$0
EC3 Undertake small scale or emergency works in entrance channel (expanded action)	$12,650,000	+$10,650,000 years 1-5	$0	$5,000,000	$0
EC4 Monitor changes to the entrance channel	$20,000	No change	$0	$0	$0
EC5 Monitor, maintain and if required upgrade channel infrastructure	$2,000,000	-$400,000	$0	$0	$0
TOTAL	**$44,430,000**	**+$33,500,000**	**$760,000**	**$8,000,000**	**$10,000,000**

Manage Foreshore and Bank Erosion Sedimentation (FB)

Action	Total projected cost for CMP across 10 years	Change from previous draft	Total projected cost to WCC		
			Year 1 (20/21)	Years 2-5 (2021-2025)	Years 6-10 (2025-2030)
FB1 Undertake bank condition assessment and implement erosion control measures	$300,000	-$10,000 year 1	$40,000	$143,333	$16,667
FB2 Improve the environmental performance of foreshore protection works	$150,000	No change	$0	$100,000	$0
FB3 Undertake bathymetric survey of the lake floor and tributaries up to the tidal limit.	$50,000	No change	$0	$33,333	$0
TOTAL	**$500,000**	**-$10,000**	**$40,000**	**$276,666**	**$16,667**

Protect and Rehabilitate Estuarine and Riparian Vegetation (EV)

Action	Total projected cost for CMP across 10 years	Change from previous draft	Total projected cost to WCC		
			Year 1 (20/21)	Years 2-5 (2021-2025)	Years 6-10 (2025-2030)
EV1 Rehabilitate vegetation and manage public access	$2,350,000	-$505,000 over 10 years	$245,334	$728,000	$593,333
EV2 Undertake targeted action to control damage to vegetation, including seagrasses	$1,100,000	No change	$83,333	$333,333	$366,667
EV3 Prepare and deliver community information program	$120,000	No change	$20,000	$26,667	$33,333
EV4 Prepare and implement estuarine vegetation mapping and monitoring program	$160,000	+$75,000 split across years 1, 6 and 10	$33,333	$6,667	$66,667
EV5 Develop and implement program to enhance opportunities for vegetation migration.	$275,000	No change	$0	$116,667	$50,000
TOTAL	**$4,005,000**	**-$430,000**	**$382,000**	**$1,211,334**	**$1,111,000**

Maintain and improve Recreational Amenity (RA)

Action	Total projected cost for CMP across 10 years	Change from previous draft	Total projected cost to WCC		
			Year 1 (20/21)	Years 2-5 (2021-2025)	Years 6-10 (2025-2030)
RA1 Manage foreshore and waterway infrastructure	$8,130,000	-$630,000	$330,000	$1,518,667	$2,750,000
RA2 Construct new sections of shared pathway	$1,520,000	No change	$50,000	$580,000	$400,000
RA3 Investigate opportunities to increase public access along the foreshore	$0	No change	$0	$0	$0
RA4 Build on the Tourism opportunities for Lake Illawarra (New)	$0	No change staff time only	$0	$0	$0
RA5 Conduct small scale dredging (New)	$700,000	+$700,000	$0	$0	$0
RA6 Investigate larger scale dredging (New)	$300,000	+$300,000	$0	$0	$0
TOTAL	**$10,650,000**	**+$370,000**	**$380,000**	**$2,098,667**	**$3,150,000**

Prepare for Inundation Risks (IR)

Action	Total projected cost for CMP across 10 years	Change from previous draft	Total projected cost to WCC		
			Year 1 (20/21)	Years 2-5 (2021-2025)	Years 6-10 (2025-2030)
IR1 Update asset management plans to identify risk of inundation	$50,000	No change	$0	$0	$0
IR2 Develop a whole of lake foreshore adaptation plan for public lands	$80,000	No change	$0	$6,667	$46,667
IR3 Incorporate tidal inundation mapping into strategic land use planning documents	$20,000	No change	$0	$13,333	$0
IR4 Undertake water level and condition monitoring for all lake inundation events	$100,000	No change	$6,667	$26,667	$33,333
IR5 Investigate solutions to manage inundation risks to assets	$30,000	No change	$0	$6,667	$13,333
TOTAL	**$280,000**	**No change**	**$6,667**	**$53,334**	**$93,333**

TOTAL

Action	Total projected cost for CMP across 10 years	Change from previous draft	Total projected cost to WCC		
			Year 1 (20/21)	Years 2-5 (2021-2025)	Years 6-10 (2025-2030)
ALL ACTIONS TOTAL	**$72,800,000**	**+$33,465,000**	**$2,142,833**	**$13,392,668**	**$15,602,166**
		$31,137,667			

Note that these costs are indicative only and are subject to usual Council planning and budgeting processes. Costs in later years, particularly years 6-10 are difficult to estimate and should be taken as a guide only.

Forward Planning and Budgeting is already occurring:

- Council divisions have existing budgets for this and next financial year that will help contribute to the achievement of actions.
- For example:
  - Natural Areas has $267,500 in the 2019/20 budget to contribute to year 1 works in action EV1.
  - Infrastructure Strategy Planning has $240,000 p.a. allocated in its existing budget to contribute to RA1 until 2022/2023, has already allocated $760,000 to EC1, allocated all required budget to action RA2 until 2022/2023.