

Narrabeen Lagoon Plan of Management



Prepared for Narrabeen Lagoon Reserve Trust
June 2011

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EXECUTIVE SUMMARY

The Narrabeen Lagoon Plan of Management (hereafter referred to as the “Plan”) provides a framework for managing Narrabeen Lagoon which is categorised as an Intermittently Closed and Open Lake or Lagoons (“ICOLL”) on the northern beaches of Sydney, NSW. Narrabeen Lagoon is owned by the State of NSW and is administered as a reserve under the NSW *Crown Lands Act 1989 (CL Act)* by the NSW Department of Primary Industries (DPI).

Warringah Council (hereafter referred to as “Council”), as a corporation, has been appointed Reserve Trust Manager of Narrabeen Lagoon Reserve Trust (R1031949) by the Minister for Lands under the *CL Act* and has worked closely with government organisations such as DPI and OEH to develop the Plan. As Reserve Trust Manager, Council is responsible for the care, control and management of the lagoon.

The Plan is a principles-based framework that provides guidance on managing the issues and values identified for the lagoon by providing broad management actions. A principles-based approach, as opposed to a very prescriptive plan, will provide for better and more effective outcomes for managing the lagoon when funding and resources are uncertain, and will not restrict the Reserve Trust Manager in following particular methods of management when other better ways may be developed between gazettal of this plan and implementation of the measure in question.

The aim of the Plan is to guide future planning, monitoring and management of the lagoon and provide a strategic tool for its management so as to balance environmental and recreational needs.

The development of the Plan involved extensive community and stakeholder consultation which provided input into the production of three key documents. This process allowed for the development of values and management strategies for the Plan and complied with the requirements of the *CL Act*.

Key components of the process included:

- Preparation of a Due Diligence Report to identify issues with potential to impact on the future management of the lagoon and/or potential liabilities for the Reserve Trust Manager.
- Development of a web page (yoursaywarringah) for the Plan containing information, frequently asked questions, discussions forums and links to key documents.
- Preparation of a Values, Issues and Options Paper which included the development of a wide ranging set of environmental and recreational values and options for consideration and prioritisation by stakeholders and the wider community along with existing information on the environment and recreation.
- Community consultation; two community workshops were held along with a forum on the yoursaywarringah website to obtain feedback from the wider community on what values and management principles should be prioritised and which were important for consideration in development of the Plan. Other community groups such as Indigenous organisations and interested volunteer groups were also consulted.
- Stakeholder consultation; DPI, the Office of Environment and Heritage¹ (OEH) and DPI-Fisheries were consulted during the development of the Plan.
- Preparation of the Draft Plan of Management based on outcomes from the Due Diligence Report, Values, Issues and Options Paper, and community and stakeholder consultation.

¹ The successor (in part) to the Department of Environment, Climate Change and Water (DECCW) which occurred during preparation of the Plan

Many environmental and recreational values were identified during the preparation of the draft Plan. These have been consolidated into the following five key values (discussed in **Section 3**):

- Natural Environment (Aquatic and Terrestrial Habitat).
- Recreation.
- Amenity.
- Flood Mitigation.
- Heritage.

Appropriate management strategies and actions as outlined in the Plan of Management (**Section 4**) have been developed to preserve and protect these values.

A total of 29 management actions have been developed which address the issues identified under the five key values and include (but are not limited to) the following key actions:

- Where necessary, investigate causes and ecological impacts of poor water quality. Work with adjacent landowners, Reserve Trusts, OEH, Sydney Water and Pittwater Council to minimise poor quality runoff discharging into the lagoon.
- Ensure satisfactory environmental assessments are undertaken for works and activities proposed within the bed of the lagoon.
- Work with Warringah Council and relevant stakeholders to facilitate holistic approach to management of public recreation on the lagoon to allow use and enjoyment of the lagoon while avoiding/minimising environmental impacts.
- Promote use of the lagoon for educational purposes.
- Use data and recommendations from adopted Flood Risk Management Plans for Narrabeen Lagoon to manage flood risk.
- Work with stakeholders (e.g. DPI) to educate the community on the sustainable use of the lagoon.
- Where appropriate, change the water depth (e.g. by dredging, infilling or other methods) of the central or western sections of the lagoon to improve recreational access without compromising its environmental values.
- Develop a financial management model for implementation by the Reserve Trust Manager.

The Plan of Management is designed to be reviewed regularly by way of an annual report of activities on the Reserve under the *CL Act*. Although the *CL Act* provides the overarching legislation for the management of the lagoon, all activities still need to comply with other legislative requirements and must be balanced in order to meet the needs and interests of the lagoon (discussed in **Section 1**).

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1 INTRODUCTION

1.1 Background

Narrabeen Lagoon is the largest of four coastal lagoons within the Warringah Local Government Area (LGA) with a surface area of approximately 2 km² and a catchment area of about 55 km². The lagoon is at various times open to the South Pacific Ocean and as such is regarded as belonging to the landscape feature referred to as Intermittently Closed and Open Lakes and Lagoons (ICOLL).

Five main creeks (Nareen, Mullet, Deep, Middle and South Creeks) feed into the lagoon and contribute to the water quality and sediment in the lagoon. Issues of water quality and accelerated sedimentation in the lagoon are directly related to land-based activities and land use in the catchment.

The lagoon is an important environmental and recreational area and is visited by over 1,000 people a day. This unique environment is a place where locals and visitors go fishing, bushwalking, swimming, kayaking, sailing, stand-up paddle boarding, boating, windsurfing, bird watching and picnicking. There are several clubs, groups and organisations that directly utilise the lagoon including the Sydney Academy of Sport and Recreation, Manly-Warringah Kayak Club, Narrabeen Lakes Sailing Club, Windsurfing NSW, Pro Kayaks and Australian Bream Tournaments (ABT).

The lagoon comprises a fragile and diverse aquatic and terrestrial ecosystem. It has been identified by the NSW Department of Primary Industries (DPI) as key fish habitat with significant seagrass meadows being a key contributor to the quality of this habitat. The seagrass meadows provide nursery habitat for economically important juvenile fish species.

Seagrass meadows also provide habitat for the Hairy Pipefish (*Urocampus carinirostris*) which is a listed marine species under Section 248 of the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. The lagoon also provides habitat for bird life and the islands within the lagoon have vegetation communities that are listed as endangered under the NSW *Threatened Species Conservation Act 1995 (TSC Act)*.

Narrabeen Lagoon is owned by the State of NSW and is administered as a reserve under the *Crown Lands Act 1989 (CL Act)* by the DPI.

Warringah Council (hereafter referred to as “Council”) was appointed as Reserve Trust Manager of Narrabeen Lagoon Reserve Trust. As Reserve Trust Manager, Council is responsible for the care, control and management of the lagoon.

SMEC Australia Pty Ltd (SMEC) was engaged by Council to prepare a Plan of Management for Narrabeen Lagoon (hereafter referred to as the “Plan”). This process involved undertaking preparation of a Due Diligence Report and a Values Issues and Options Paper, and holding two community consultation workshops. The outcomes of the two reports and community workshops as well as an online forum were used to develop the management priorities and actions for the lagoon.

This Plan will assist the Reserve Trust Manager in the sustainable management of the lagoon.

It should be noted that the Plan of Management is intentionally structured to facilitate flexibility in its implementation and therefore differs from typical management plans which are usually more prescriptive in nature. Another key difference is that a Plan of Management is developed under the *CL Act* and must address specific criteria. Further discussion on this is provided in **Section 1.3**.

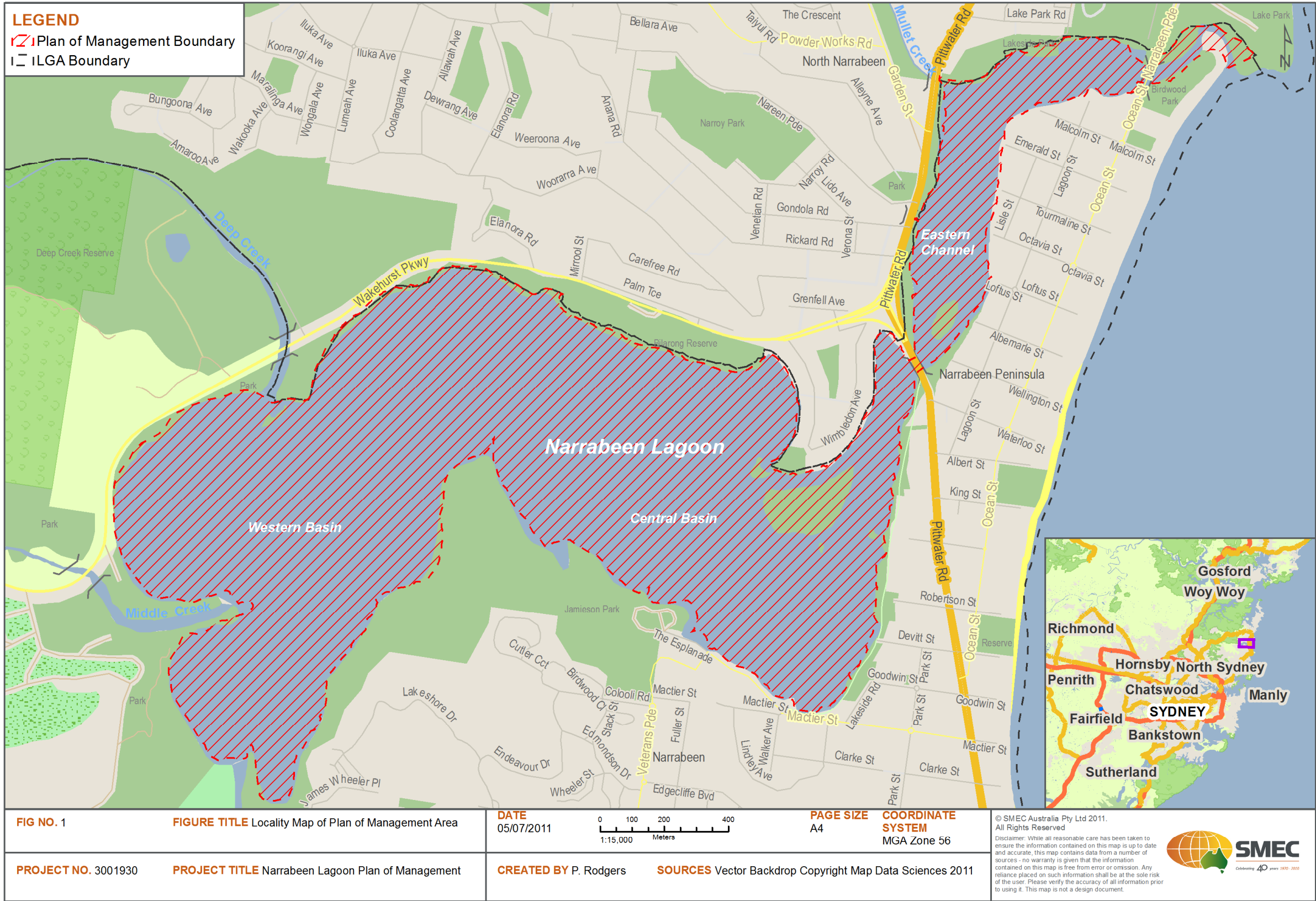
1.2 Land to Which This Plan applies

Narrabeen Lagoon is located approximately 25 kilometres northeast of the city of Sydney on the northern beaches (**Figure 1**). The majority of the lagoon is situated within the Warringah LGA.

The area to which this Plan applies is the bed of Narrabeen Lagoon to 0.7 mAHD (and the two islands within the lagoon, Wimbledon Island and an unnamed smaller island east of the Pittwater Road bridge) which falls within Warringah LGA and within that to which the Narrabeen Lagoon Reserve Trust is trustee, this being:

- Narrabeen Lagoon Reserve 1031949 for Public Recreation and Coastal and Environmental Protection.
- Dedications D500510 and D1000488 for Public Recreation (known as Wimbledon Island).

The limitation of this Plan to 0.7mAHD (notwithstanding the two islands noted above) was determined following analysis of historic lagoon water levels, tidal range, topographical information and survey data. **Figures 2** and **3** show the area to which this plan applies (noting that the boundaries are indicative only).



Location: I:\projects\3001930 - Narrabeen Lagoon Plan of Management\009\DATA\GIS

Figure 1: Location of Narrabeen Lagoon



Figure 2: Parcels of Land included in the Plan (noting that the boundaries shown are indicative only and the land affected is described in Section 1.2)

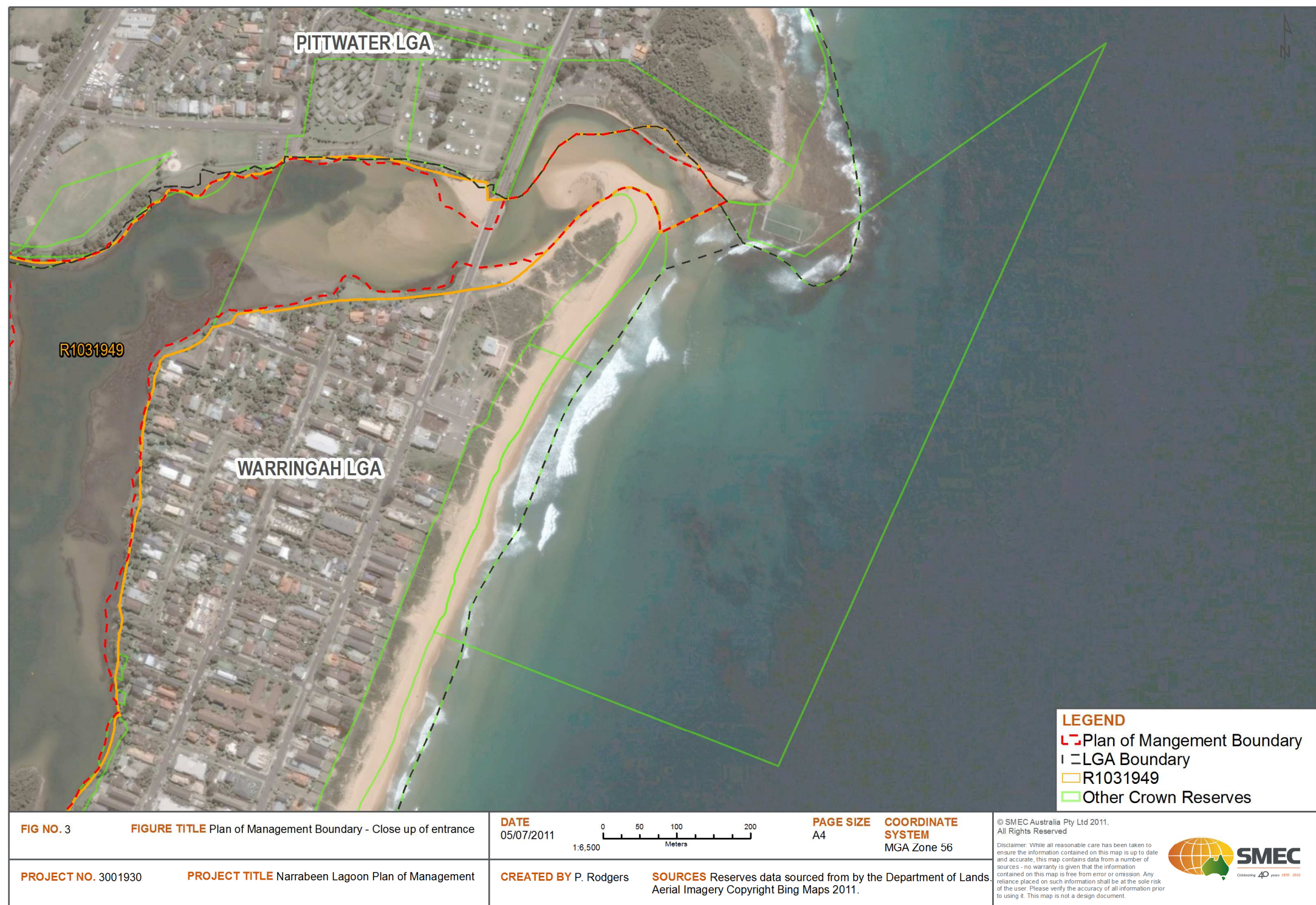


Figure 3: Parcels of Land included in the Plan at the entrance to Narrabeen Lagoon (noting that the boundaries shown are indicative only and the land affected is described in Section 1.2)

1.3 Objectives of the Narrabeen Lagoon Plan of Management

This Plan is a principles-based framework that is intended to provide high level guidance on managing the values identified for the lagoon by providing strategic and flexible actions, performance targets and performance measures. A principles-based approach, as opposed to a prescriptive plan, will provide for better and more effective outcomes for managing the lagoon when funding and resources are uncertain, and will not restrict the Reserve Trust Manager to specific methods of management when other better ways may be developed between gazettal of this plan and implementation of the measure.

Specific action plans and/or sub plans can be developed in keeping with the broad principles of this Plan when they become necessary and/or when sufficient funding is available. The relationship of these to this Plan and other related Plans of Management is shown in Figure 4.

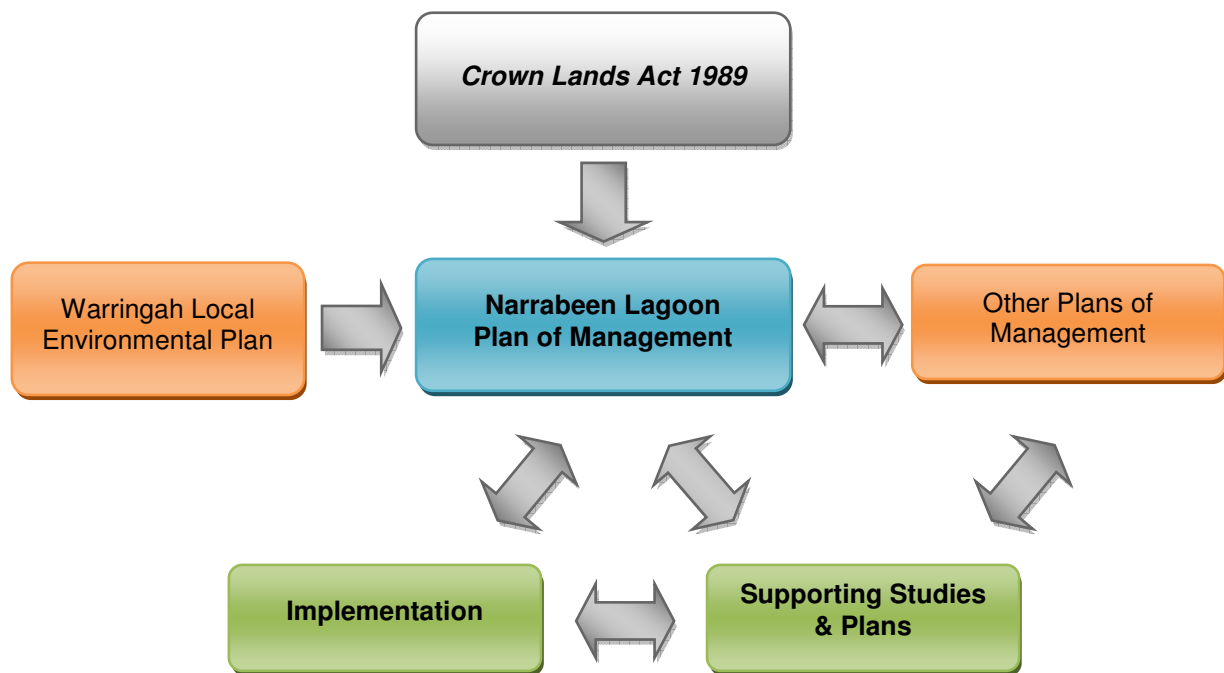


Figure 4: Context of Narrabeen Lagoon Plan of Management and related documents

This Plan will guide the Reserve Trust Manager in future planning, monitoring and management of the lagoon, and will provide a strategic tool for the Reserve Trust Manager to balance competing environmental and recreational needs.

The objectives of the Plan (identified in **Section 4, Table 2**) are to:

- Establish water quality outcomes suitable for protection of the natural environment and for public recreation.
- Maintain and enhance the natural environment.
- Promote and enhance the unique environmental, cultural heritage and amenity values of the lagoon.
- Promote coastal environmental protection.
- Manage sustainable, diverse and appropriate uses of the area for recreation.
- Manage potential impacts of flooding on commercial and residential properties as identified in an adopted Flood Risk Management Plan.
- Establish and maintain effective administration for implementing strategies.

1.4 Vision For Narrabeen Lagoon

This Plan was developed to protect and enhance the environmental and recreational value of Narrabeen Lagoon as part of a wider commitment by Warringah Council to protect its natural assets. This commitment is captured in the vision statement for the Warringah LGA:

“A vibrant community, improving our quality of life by living and working in balance with our special bush and beach environment.”

The key values for Narrabeen Lagoon are linked to the environmental features and recreational amenity of the lagoon. Common recreational activities such as swimming, sailing, fishing and kayaking are extremely popular and their enjoyment is closely linked to water quality, and aquatic and terrestrial habitats. However, at times conflict arises in the management of recreational and environmental needs and this Plan, along with documents developed under it and related to it (refer Section 1.3), is designed to provide guidance in managing sometimes conflicting requirements of the environment and its use for recreation.

A vision statement for Narrabeen Lagoon will provide a basis for development of management strategies and assist in review and revision of the Plan into the future. It will give the Reserve Trust Manager a guiding principle for management of the lagoon. Based on community consultation and promoting the public purpose of coastal environmental protection and public recreation, a vision statement for Narrabeen Lagoon has been developed:

"Working together for the protection and enhancement of the environmental and recreational values of Narrabeen Lagoon".

1.5 Guiding Principles of Management

The Reserve Trust Manager will manage the lagoon in keeping with the following guiding principles:

- Sustainable management of Narrabeen Lagoon that promotes and protects the lagoon and balances environmental and public recreational values.
- Compliance with relevant legislation, policies and plans.
- Sustainable financial management that seeks and allocates funding based on greatest environmental benefit.
- Good working relationships with surrounding land managers that promote the best interests of the lagoon.
- Safe and equitable access.

Management actions have been developed around these guiding principles and are detailed in **Section 4**.

1.6 Relationship Between This Plan and Other Key Lagoon Management Documents

The management of Narrabeen Lagoon is governed primarily by two documents:

- The Narrabeen Lagoon Floodplain Management Plan (adopted by Council in 2003).
- The Narrabeen Lagoon Estuary Management Plan (adopted by Council in 2002).

These documents inform Council about the management actions it should take with regard to floodplain and estuary management issues. It is important to note that regardless of what these documents independently state, there is a suite of other legislation that must also be considered. These legislative requirements ultimately determine what actions can be undertaken within the area occupied by the lagoon.

On 27 March 2007, Council adopted an addendum to the Estuary Management Plan which called for investigations into undertaking carefully planned and managed dredging of the Central Basin as part of the Narrabeen Lagoon Restoration Project. While undertaking these investigations, it became apparent that the primary benefit of undertaking dredging was improved recreational access rather than solely for environmental benefit. It was identified that currently there was no planning process in NSW that would permit this type of activity.

Clause 65 of *State Environmental Planning Policy (SEPP) Infrastructure 2007* permits development for any purpose without consent if the development is for the purposes of implementing a Plan of Management adopted for the land under the *CL Act*. The NSW Minister for Lands has confirmed that a Plan of Management would be required for dredging activities related to recreational access.

This Plan provides for appropriate recreational dredging on the bed of the lagoon which is presently prohibited under the current Warringah LEP. The Plan is also designed to provide a framework for the sustainable management of the lagoon, balancing both recreational and environmental requirements.

1.7 Legislative Framework

The management of development and activities affecting Narrabeen Lagoon is governed by a range of legislative requirements. **Appendix 1** outlines the key NSW (**Table A1**) and Commonwealth (**Table A2**) legislation and environmental planning instruments (**Table A3**) applicable to this Plan of Management. **Table A1** also identifies approvals, licences and permits that may be required for development and activities affecting the lagoon.

Other potentially relevant legislation, plans and policies are also listed in **Appendix 1**.

It is important to recognise that this Plan outlines activities that are authorised uses of the reserve. However, any proposed activity or development must comply with applicable legislative requirements and be consistent with relevant policies and plans such as those listed and described in **Tables A1, A2** and **A3**. Appropriate environmental, social and economic assessment is required for any action undertaken under this legislation.

2 DEVELOPMENT OF NARRABEEN LAGOON PLAN OF MANAGEMENT

2.1 Overview

The development of this Plan encompassed eight stages, with two key documents underpinning the drafting of the plan of management (**Figure 5**).

The Due Diligence Report was the first document to be prepared. It was designed to identify issues that have the potential to impact on the future management of the lands included in the Plan. Information from the Due Diligence Report was used to inform Warringah Council of potential liabilities it would be taking on as Reserve Trust Manager of the lagoon under the *CL Act* and to inform the development of the Values, Issues and Options Paper and the draft Plan.

The Values, Issues and Options Paper was the second document in the process. This identified a wide ranging set of environmental and public recreational values. Options were subsequently developed for consideration and prioritisation by stakeholders and the wider community along with baseline information on the environment.



Figure 5: The Plan of Management Development Process

2.2 Community Consultation

Input from local residents and users of the lagoon were considered to be key components in the development of a successful Plan of Management. Straight Talk, a specialist consultation service provider, was engaged by SMEC on behalf of Council to undertake community consultation to inform the development of this Plan. Consultation activities were designed to engage a broad spectrum of the community including representatives from recreational groups that use the lagoon, interest groups, casual visitors, Indigenous groups, residents and local businesses. Activities were focused on identifying values and issues and responses to potential management options. The activities were structured to ensure the diversity of opinions was recorded. Consultation activities were staged to ensure community feedback including the communities values was incorporated into the development of the Plan.

Key government stakeholders were also engaged throughout the development of the Plan including Council, DPI and the NSW Office of Environment and Heritage (OEH).

2.2.1 Approach

The two stages of community consultation conducted during development of the Plan comprised:

- Stage 1 - A community workshop was held and a website and online discussion forum (at yoursaywarringah) established to identify values of the lagoon and issues to be addressed in the Plan (September - October 2010). An initial Values, Issues and Options Paper was developed through consultation undertaken during this stage.
- Stage 2 - Exhibition of the initial Values, Issues and Options Paper with call for submissions. Updating of the website and online forum also occurred. A further community workshop was undertaken to discuss the content of the Values, Issues and Options Paper and identify preferred management options (November- January 2011).

The exhibition of the Draft Plan of Management comprised the third stage of community consultation. Submissions have been considered in finalising the Plan.

2.2.2 Activities

Stage 1

Stage 1 activities began in late September 2010. Members from the community and other stakeholders were invited to participate in an online discussion forum and an interactive community workshop.

The online discussion forum, www.yoursaywarringah/narrabeenLagoonPOM, was established and linked to Council's website on 29 September 2010.

The first community workshop was held on 21 October 2010 and was designed to identify:

- Community values associated with the lagoon.
- Issues that needed to be managed to protect community values.
- Potential options for managing issues.

The principal aim of the first online discussion forum and the community workshop was to gather information on what the community valued about the lagoon and the major issues they saw in managing and protecting it.

Consultation for the online forum and community workshop was promoted through:

- Advertisements in the Manly Daily.
- Posters at community venues and around the lagoon.
- Warringah Council's website.

- Letters of invitation sent to stakeholder groups and schools.
- Promotion by Council staff at the lagoon and Narrabeen Markets.

Participants in the online discussion forum and the community workshop were asked to identify the features of the lagoon they valued the most, the issues that needed to be managed and the best possible outlook for the lagoon. Outcomes from Stage 1 activities were documented as an input to the Values, Issues and Options Paper.

Stage 2

Stage 2 activities commenced in late November 2010 and focused on broad management options. To allow the community to provide input into the management options, a second community workshop was held on 25 November 2010. A second online discussion forum focusing on management options was also made available through the yoursaywarringah website.

Consistent with the publicity approach used for the first workshop, promotion for the second workshop included an advertisement in the local paper, letters to stakeholder groups and schools, posters at community venues and around the lagoon, an email alert to registered users of the online discussion forum and campaigning at Narrabeen Markets and around the lagoon by Council staff. Participants in both the online discussion forum and the community workshop were asked to review management options identified in the Values, Issues and Options Paper to identify gaps and shortlist those they felt were most important for the long term management of the lagoon.

At the workshop, participants initially worked in groups to shortlist management options and then worked independently to reflect on the shortlisted options and identify those:

- Supported as an appropriate use of resources.
- Opposed as an inappropriate use of resources.

The Values, Issues and Options Paper was made publically accessible for comment via the website for a six week period until 14 January 2011.

The following sections detail outcomes of Stage 1 and Stage 2 activities. This information was obtained from the consultation outcomes report prepared by Straight Talk in January 2011.

Stage 3

Stage 3 consultation activities involved the public exhibition of the Draft Plan of Management, with a call for submissions. The feedback received was considered before the Plan was finalised.

2.2.3 Results and Outcomes

Stage 1

The first community workshop was attended by 36 people. During Stage 1 consultation activities, the yoursaywarringah website was visited 1,750 times and 55 comments were received through the first online discussion forum.

Outcomes of this stage of the community consultation process were incorporated into a draft version of the Values, Issues and Options Paper.

In summary, values and issues identified through Stage 1 consultation activities reflected the need to manage the lagoon to:

- Protect the beauty and tranquility.
- Ensure long term sustainability.
- Minimise pollution to maintain and improve the water quality.
- Optimise the water level.

- Promote and enable a balanced mix of recreational uses.
- Ensure safe use and access.
- Sustain the variety of plants, animals and microorganisms.
- Value the historical and heritage significance.
- Regulate the entrance appropriately.
- Mitigate the impact of the surrounding highly urbanised catchment.

Consultation identified widespread support for Council to manage the lagoon in a holistic way and to balance environmental, amenity and recreational needs. However, it identified mixed views about whether Council should control the water depth by dredging or whether the entrance should be regularly cleared to keep it open.

The attendance at the community consultation workshop and the number of people who made comment through the online discussion forum represent a very small number of the people who live in Warringah LGA and use the lagoon. Though all public participation is valued it should be noted that outcomes from the workshop and online forum might not capture the wider views of the public.

Stage 2

The second workshop was attended by 58 people. During Stage 2 consultation activities, the yoursaywarringah website was visited 590 times and seven comments were received on the second online discussion forum.

Six public submissions were received on the Values, Issues and Options Paper. In addition, three comments were received at the second workshop which were acknowledged as additional submissions. All comments received on the Values, Issues and Options Paper were considered for inclusion into the final document.

The consultation activities were designed to gauge a general level of support for a range of potential management principles to enable the Plan to be developed with an understanding of community preferences. The management principles outlined in the Values, Issues and Options Paper provided a discussion framework for Stage 2 activities.

During the second workshop, the management options were numbered and assessed to identify those that were seen as being most important for management of the lagoon. The workshop activities allowed participants, after considered (but time limited) discussion, to identify which specific management principles were considered to be of more consequence than others. Preferences and individual support for management options were captured and ranked through both group and individual activities throughout the workshop and were also captured via the online discussion forum.

It should be noted that individual support for specific options may have been influenced by personal opinions and values as well as workshop discussion. Due to conflicting values and varied opinion about the importance of different management issues, there was mixed support for a number of the management principles. This highlights the need for Council to explore tradeoffs and identify management principles that reflect community preferences and optimise outcomes to safeguard the lagoon.

Through this process the management principles that had the most group community support were as follows:

- Investigate waste management options including ways to reduce the volume of rubbish getting into waterways together with enforcement of littering offences.

- Floodplain management including management flood analysis and options to reduce flooding (e.g. entrance clearance).
- Consideration of providing increased water depth where positive cost benefit and appropriate environmental assessment completed.
- Holistic approach to management of recreation on the lagoon to allow use and enjoyment of the lagoon while minimising environmental impacts.

Similar to Stage 1 consultation, the number of attendees at the community consultation workshop and the number of people who made comment through the online discussion forum represent a very small number of the community that resides in the Warringah LGA. Therefore it should be noted that outcomes from the workshop and online forum may not capture the wider views of the public.

A community consultation report (Straight Talk 2011), summarising the outcomes of the community workshops and online discussion forum, and comments received on the Values, Issues and Options Paper, assisted in informing the development of the Plan. In particular, feedback received through the community consultation was used to develop the draft Plan of Management (**Section 4**) and the ranking of the management actions (**Section 4, Table 2**).

The management options presented in the community workshop were developed and refined into principle-based management targets and actions. **Appendix 2 (Table A4)** shows where each of the management options used in the community consultation workshop have been incorporated into the principle-based actions of this Plan.

2.2.4 Key Issues Identified

A number of key themes were identified from analysis of the management principles that were short-listed through the consultation process. There was general consensus regarding several key themes. However, the majority of key themes reflect the existence of conflicting values and varied opinions about different management issues and approaches.

Cost benefit and technical investigation

Notwithstanding the need for appropriate environmental assessment, there was mixed response to management principles that proposed additional technical studies or analysis. Accordingly, if further technical investigations need to be undertaken, the rationale and benefit of undertaking additional scientific reporting will need to be clearly outlined and technical investigations clearly linked to tangible actions.

Water quality and pollution control

There was general consensus and widespread recognition of the need to protect and improve water quality through better pollution control including control of nutrients, sediment and rubbish from all sources. Management principles that provided for improved waste management and enforcement were generally supported. There was strong support to explore opportunities to reduce the volume of rubbish entering the lagoon, enforce anti-littering controls, manage sediment and nutrients, maintain water quality and improve waste reduction strategies. However, there was opposition to exploring opportunities to improve the quality and quantity of stormwater entering the lagoon.

Given the widespread recognition of the need to manage the high volume of pollutants originating in the upper catchment that run off to creeks draining to the lagoon, this apparent contradiction is difficult to account for. The opposition may relate to resistance to reuse of stormwater by households which was listed as an example of one way of managing stormwater. There may have been some association that reuse included grey water recycling. Alternatively, the opposition may reflect a level of confusion about the links between stormwater management and water quality. While it is difficult to account for this anomaly, it is accepted that there is general support to improve water quality through pollution control measures.

Flooding risk

There was a mix of views about the nature of flooding risk within the catchment and the need for it to be investigated or managed differently. While it was recognised that the frequency of high rainfall events was increasing and will increase the impact of flooding across the catchment, there were differing levels of support for changing the approach to flood management which may reflect different views about climate change. There was strong opposition to assessing the likely impact of climate change on flood risk or planning for increased frequency of flooding due to climate change. However, there was strong support to manage the floodplain in accordance with legislative requirements and to implement measures to reduce flooding and protect property.

There was a view that flooding risk was already on the policy agenda, that sufficient flood risk analysis had been undertaken and that flood risk was being adequately managed (e.g. building codes). As such, there was some support to implement current flood management plans and not review them or undertake further flood risk analysis. It was clear that, while there were different views about the need for and benefits of entrance clearance, there was differing levels of understanding about the role entrance clearance plays in flood mitigation. There was also a view that new development controls were needed to prevent further development within the floodplain.

Value of education

There was a mix of views about the need for and benefit of public education with general opposition to education that was seemingly based on the belief that the cost benefit would be low. There was a view that education and signage may have limited impact and that it needs to be supported by improved enforcement efforts.

Recreational use

There was a mix of views about the need to manage powered watercraft which reflect different values about recreational use. There was also a strong response opposing the need to investigate water depth to manage recreational use which was seemingly based on the belief that the cost benefit would be low, especially given the continual changes to the lagoon bed.

Entrance clearance

There was a mix of views about the role entrance clearance plays in controlling water quality. There was strong support to regularly review the approach to entrance management and to manage the lagoon entrance in an efficient and effective way. However, it was clear that there are different views about the most efficient and cost effective approaches for entrance management, with polarised opinions about a range of approaches including entrance dredging and construction of a break wall.

Water depth

There was a mix of views about increasing water depth for recreational use, with strong support for it provided environmental assessment was undertaken to confirm minimal impact on sea grass beds. However, there was opposition to bathymetry investigations reflecting the view that these investigations had already been undertaken. There was some support for more frequent investigations however opposition was also expressed given that the lagoon bed changes continually.

Ecological protection

There was widespread support to minimise the impacts associated with use of the lagoon to ensure sensitive ecosystems are protected. Accordingly, the Reserve Trust Manager needs to ensure that environmental impact assessments are undertaken where necessary to ensure measures for mitigating environmental impacts are identified and implemented.

Summary

While the outcomes of consultation are somewhat inconclusive they have been considered in the preparation of the Plan. There was recognition that management of the lagoon needs to comply with relevant legislative requirements and link to action to safeguard the future of the lagoon.

There was broad support for:

- Managing waste, including nutrients, sediment and rubbish.
- Mitigating flood risk.
- Undertaking environmental assessment.
- Protecting ecosystems.
- Increasing water depth at appropriate locations, with due consideration of environmental impacts.
- Enabling mixed low impact recreational uses.
- Embracing a holistic catchment wide management approach.

2.3 Public Exhibition of the Draft Plan of Management

The draft Plan was placed on public display from 3 May 2011 to 10 June 2011 in accordance with the requirements of the *CL Act*. Public submissions on the draft Plan were invited and were considered prior to finalisation of the Plan and adoption by the Minister administering the *CL Act*.

As the study area includes “submerged Crown land” (land that is covered by water), the draft Plan is required to be referred to (and requires the concurrence of) the Minister administering the *Fisheries Management Act 1994 (FM Act)* before adoption.

A total of 15 submissions were received; four were from public authorities and the remainder from community groups and individuals. All submissions were reviewed and relevant issues identified. A response to these is provided in Appendix 3. Individuals have not been identified for privacy reasons.

Several submissions considered there to be a lack of detail with regard to the performance targets, performance measures and commitment to implement actions. As previously described in **Section 1.3**, this Plan has been prepared as a principles-based plan. The Plan is intended to be used as a tool to enable the most appropriate actions to be developed and undertaken at the time of implementation as determined by the Reserve Trust Manager. Actions will be implemented as required and will be subject to available funding and resources. It does not provide prescriptive actions.

2.4 Future Consultation

After the Plan is adopted, community consultation will continue as the Plan is implemented in line with Warringah Council’s Community Engagement Policy and Council’s Strategic Community Plan.

3 KEY VALUES OF NARRABEEN LAGOON

3.1 Overview

The purpose of this section is to outline:

- The key values of Narrabeen Lagoon and why they are important.
- A vision for the future of Narrabeen Lagoon.

“Values” can be described as “what is important about a place”. During the preparation of this Plan, including the community consultation described in **Section 2.2**, a number of environmental and recreational values were identified. These reflected the need to manage the Lagoon to:

- Protect the beauty and tranquility.
- Ensure long-term sustainability.
- Minimise pollution to maintain and improve the water quality.
- Optimise the water level.
- Promote and enable a balanced mix of recreational uses.
- Ensure safe use and access.
- Sustain the variety of plants, animals and microorganisms.
- Value the historical and heritage significance.
- Regulate the entrance appropriately.
- Mitigate the impact of the surrounding highly urbanised catchment.

These were consolidated into the following key values that cover four broad areas as follows:

- **Natural environment.** The area under consideration contains a limited amount of terrestrial vegetation, as the study area is limited to 0.7 mAHD. Nonetheless terrestrial flora and fauna are a key component of the natural environment of Narrabeen Lagoon. The aquatic environment is particularly important since the area supports important seagrass and saltmarsh communities and the combination of natural bushland and features of the aquatic environment provide habitat for 193 bird species. Aquatic processes considered include water quality, the inherent characteristics of an ICOLL, as well as the effects of human-induced disturbance from dredging and storm water inputs.
- **Water based recreation.** The proximity of bushland and the aquatic environment associated with an ICOLL means that Narrabeen Lagoon is a popular place for swimming, sailing, kayaking and fishing. The popularity of Narrabeen Lagoon for recreation is also due to surrounding development not unduly spoiling the natural environment and amenity of the area.
- **Amenity.** The community has identified the peace and scenic quality of the lagoon as unique in the Sydney area and it is important that it be preserved. Accessibility to people from all groups, including those with disabilities is also important, as is balancing the requirement for commercial and residential premises in the vicinity of the lagoon and potential impacts from these on the lagoon.
- **Flood mitigation.** Many commercial and residential premises in close proximity to the lagoon are at risk of flooding. It is important that the impacts of flooding are minimised.
- **Heritage.** The lagoon has both cultural and Indigenous heritage values. It is important that future management of the lagoon maintains these values.

The values and significance of the Narrabeen Lagoon were assessed based on feedback provided by stakeholders and the community. Subsequently these values became the basis for development of appropriate management strategies and actions outlined in **Section 4** of this Plan.

3.2 Natural Environment

3.2.1 Aquatic Environment

3.2.1.1 Estuarine Vegetation

Key areas of aquatic habitat for Narrabeen Lagoon are foreshore reed lands, saltmarsh and seagrass (**Figure 6**). The key characteristics are:

- The foreshore reed lands provide high quality habitat for fish and invertebrates during middle and high tides. They also function to protect the lagoon foreshore as well as adjacent residential and commercial development (The Ecology Lab Pty Ltd 2007).
- Estuarine vegetation, including seagrass, is protected under the *FM Act*. Seagrass functions to slow down water currents and stabilise the seabed and provides important habitat for aquatic fauna particularly fish breeding grounds and nurseries for juvenile fish. The seagrass species that occur in Narrabeen Lagoon are primarily Paddleweed (*Halophila* sp.) and Eelgrass (*Zostera capricorni*), with a small amount of *Ruppia spiralis* (The Ecology Lab Pty Ltd 2007).
- A saltmarsh comprises a community of plants and low shrubs that can tolerate high soil salinity and occasional inundation from salt water. Coastal Saltmarsh is listed under the *TSC Act* as an Endangered Ecological Community (EEC) in Part 3 of Schedule 1 to the Act and is prescribed as 'Protected Marine Vegetation' under the *FM Act*.

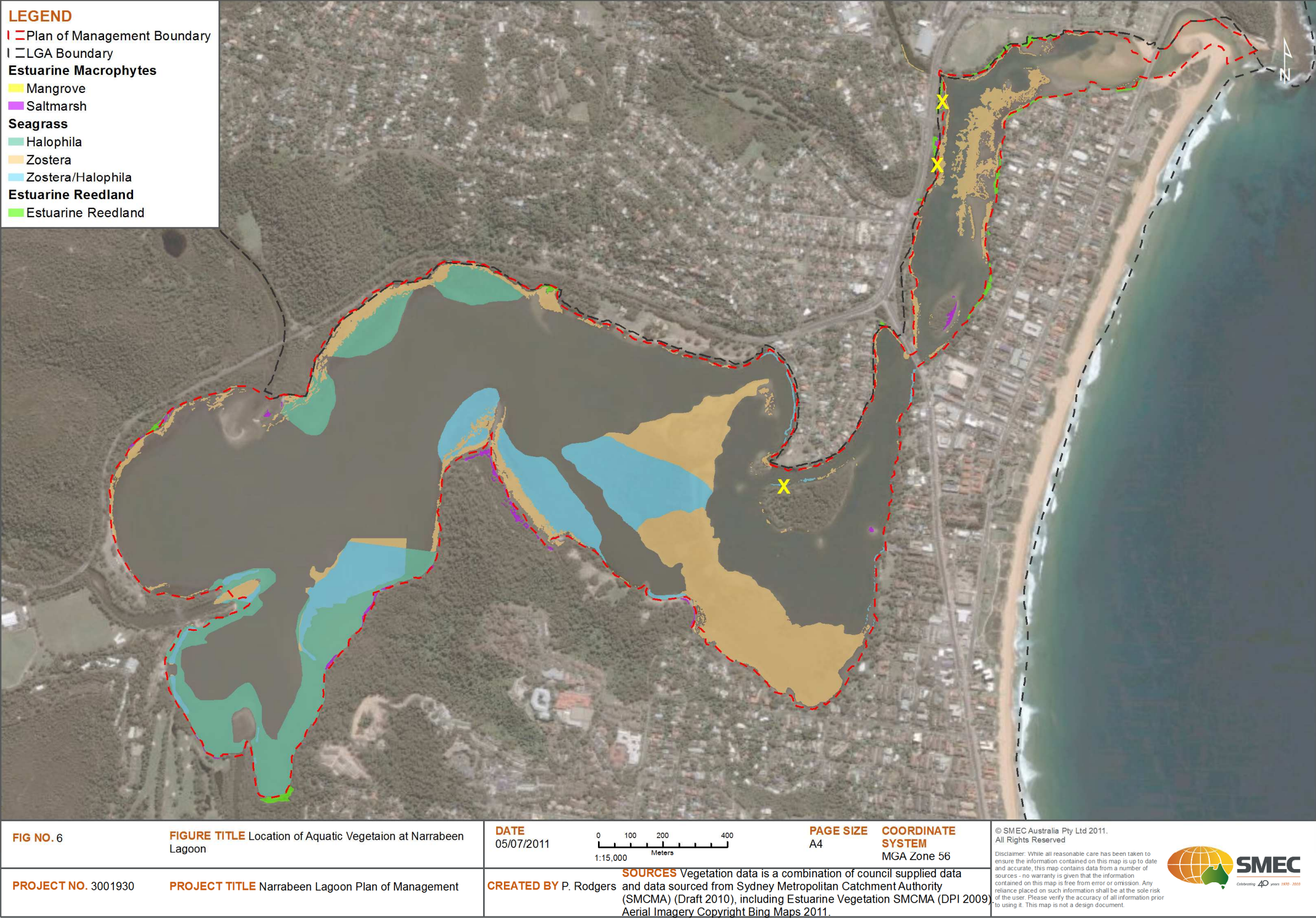
The ecological values of each of these aquatic habitats are outlined as follows.

Seagrass

Seagrass communities are a key component of many coastal ecosystems (Kikuchi 1980; West 1983). Seagrass grows below the high tide level in sheltered waters of estuaries. They are usually restricted to the upper two metres of water where there is sufficient light (NSW Fisheries 2004); although seagrass can be found distributed at different depths in response to variations in turbidity of the waters.

Seagrasses contribute to detrital food chains by their high rates of primary production (King 1981). They can harbor a range of associated biota from juvenile and adult fish, various species of alga, molluscs, bristle worms and nematodes. Seagrass functions to slow down water currents and increase sedimentation; the seagrass roots and rhizomes stabilise the seabed (King 1981; Gambi *et al.* 1990). Any change or loss of seagrass habitat can have secondary effects including disruption of estuarine food webs, altered species composition, reduced density and diversity of estuarine fish and crustaceans, and increased turbidity and erosion.

Seagrass occurs in Narrabeen Lagoon where it is recognised as providing habitat for a range of fish and other biota (**Figure 6**). Two seagrass genera, *Halophila* (Paddleweed) and *Zostera* (Eelgrass), are listed as protected under the *FM Act* and have been recorded in the lagoon and its tributaries. Smith and Smith (2005a *in* Smith and Smith 2009) considered seagrass to be a threatened community in the Warringah local government



Location: I:\projects\3001930 - Narrabeen Lagoon Plan of Management\009\DATA\GIS

Figure 6: Location of Aquatic Vegetation within Narrabeen Lagoon

area and two species that make up the seagrass community in Narrabeen Lagoon were also considered to be regionally significant by these consultants. As well, *Halophila decipiens* (Sea Wrack) is considered by Smith and Smith (2009) to be regionally uncommon while *Zostera capricorni* (Eelgrass) was regionally common. Nonetheless, these species could be useful indicators for gauging the environmental condition and biological diversity of Narrabeen Lagoon.

Seagrass can be easily destroyed and if seagrass meadows are damaged, their recolonisation can be very slow. The leaves of the seagrass grow quickly but the rhizome grows relatively slowly. The ability of seagrass to recover after disturbance varies between seagrass species. *Halophila* species are relatively quick to respond to change and may recover from damage within months, while *Zostera* species can take several years to recolonise denuded areas (West 1990; West and Larkum 1983).

The extent of seagrass has declined in NSW (Larkum and West 1990; NSW Fisheries 1999) and at least half of the State's estuarine seagrass has been lost over recent decades (Poiner and Peterken 1995). Most of this loss is due to eutrophication of estuarine waters, increasing algal growth, which leads to seagrass dieback. The condition of seagrass in NSW is highly variable but in general seagrass beds near urban or industrial areas are degraded, however some isolated seagrass areas are in good health (NSW Fisheries 1999). In Narrabeen Lagoon seagrass experienced a decline in the 1970s and some areas have continued to decline, however, there is also evidence of recolonisation by eelgrass with a resultant small increase in total area of seagrass in the lagoon (The Ecology Lab Pty Ltd 2007). A recent survey (Cardno Ecology Lab 2011) of seagrass in the south western corner of the lagoon recorded more than double the area of mapped by DPI in 2009. This may be a localised increase in area or a function of the different mapping techniques and does not imply that seagrass has increased throughout the lagoon. Data from this survey has been added to the seagrass area of **Figure 6**.

Key pressures for seagrass communities are changes in drainage, land management practices that lead to increased sedimentation, direct removal of seagrasses by dredging, boating, fishing, nutrient run-off and point source discharges from stormwater drains and introduced pests and diseases (Butler and Jerakoff 1990). It is likely that some of these issues may be influencing the condition of the seagrass community in Narrabeen Lagoon.

Saltmarsh

Saltmarsh occurs in small patches mostly in and around the Eastern Channel (**Figure 6**). This community is usually found in the upper coastal intertidal zone between land and salty or brackish water. The saltmarsh vegetation community is dominated by dense stands of halophytic (salt-tolerant) herbs, grasses, and low shrubs (Adam 1990; Woodroffe 2002) that play an essential role in trapping and binding sediments entering the waterway from the catchment. Trapping and binding of sediments aids in the process of land making. This process also protects coastal areas from erosive effects of storm events and extreme tides.

Saltmarsh acts as an ecological buffer, balancing nutrients and organic matter between saltmarsh and other interacting systems including mangroves, seagrass, open water systems and groundwater (Cappo *et al.* 1995). It plays a large role in the aquatic food web providing habitat for juvenile fish and crustaceans and exporting nutrients to coastal waters. It also provides support to terrestrial animals such as migrating birds and several bat species.

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions is listed as an EEC under the *TSC Act*. This means that this ecological community could become extinct or is in immediate danger of extinction. In 2010, saltmarsh on public water lands was prescribed as marine vegetation protected under the *FM Act*.

Saltmarsh occurs in a very small part of the study area, being confined to very small areas north west of the lagoon and on the small unnamed island east of the bridge (**Figure 6**). WBM (2001) mapped several other small areas of saltmarsh within the study area not included in the mapping that was undertaken by DPI (Fisheries) in partnership with the Sydney Metropolitan CMA. These

were located at the end of The Esplanade, south of the lagoon and another small patch was located just off the water's edge at the end of Narrabeen Street (WBM 2001) (**Figure 6**).

The saltmarsh that occurs along parts of the lagoon foreshore comprises *Juncus kraussii*, *Bacopa monniera*, *Fimbristylis ferruginea*, *Paspalum vaginatum*, *Samolus repens*, *Sarcocornia quinqueflora* and some *Phragmites australis* (Smith and Smith 2009). Several regionally significant plant species have been recorded in this vegetation community at Narrabeen Lagoon. *Azolla filiculoides* and *Cyperus laevigatus* are considered to be regionally uncommon, *Bacopa monniera*, *Leptinella longipes* and *Paspalum vaginatum* are moderately common while *Fimbristylis ferruginea* is considered common (Smith and Smith 2009).

Best practice guidelines have been published to improve and/or maintain the condition of the saltmarsh community over time. Options include staged weed removal to ensure minimal disruption to the saltmarsh community, maintaining a diversity of regenerating native species and natural tide flows, controlling and eliminating litter, restricting access by walkers, bike riders and vehicles (State of NSW and DECCW 2008).

Estuarine Reedland

The Estuarine Reedland community occurs along the shores of Narrabeen Lagoon (**Figure 6**). This community is dominated by the common reed, *Phragmites australis*. These reed beds can provide high quality sheltering habitat for fish and invertebrates during middle to high tides.

The presence of *P. australis* indicates that freshwater runoff could have inundated saltmarsh areas for extended periods and *P. australis* has succeeded the saltmarsh. This is because natural flooding of the saltmarsh by freshwater can occur, but to maintain the health of the saltmarsh this process must be balanced with regular tidal flushing. Extended inundation of saltmarsh habitats by freshwaters can cause dieback of saltmarsh species and change the species composition to favour more freshwater aquatic species, such as *P. australis*. Balleto and Weinstein (1999) found that *P. australis* spreads rapidly and forms extensive stands in tidally isolated saltmarshes. This process alters the landscape, hydrology, ecology and function for the saltmarsh.

Estuarine Reedland around the lagoon contains several regionally significant flora species. Regionally uncommon species include: *Azolla filiculoides*; *Bacopa monniera*; *Cyperus laevigatus*; *Fimbristylis ferruginea*; *Isolepis cernua*; *Paspalum vaginatum*; and *Villarsia exaltata* (Smith and Smith 2009). Common but regionally significant species are *Fimbristylis ferruginea* and *Leptinella longipes* (Smith and Smith 2009).

Mangroves

Mangroves are a group of trees and shrubs that are capable of growing in marine, estuarine and, to a limited degree, fresh water. They occupy the fringe of intertidal shallows between the land and the sea. Because of their importance as habitat for fish, mangroves are protected in NSW under the *FM Act* (Enviroscape Consultancies 2004).

In 2004, there were four known mangrove areas within Narrabeen Lagoon. These were located at Mullet Creek, Jamieson Park, Pipeclay Point, and noting that two areas also exist at Jamieson Park (Enviroscape Consultancies 2004). However, there is no official mapping of these areas. Mapping by DPI in 2009 show an area on Wimbledon Is and two areas near Mullet Creek (see **Figure 6** noting that the symbol shows the location and not the expanse of the mangrove areas). It is likely however, that the locations of various patches of mangroves may change overtime due to tidal fluctuations.

Mangroves were not recognised as inhabitants of Narrabeen Lagoon until quite recently and anecdotal evidence suggests that they are increasing in the lagoon. This is likely to be the result of the lagoon entrance being open more frequently and for longer periods resulting in a more marine environment. The expansion of mangroves in the lagoon may need to be assessed and managed accordingly in the future.

3.2.1.2 Aquatic Fauna

Benthic macroinvertebrates

Benthic macroinvertebrates are bottom-dwelling animals without backbones. They perform important ecological functions, such as nutrient recycling and provision of a food resource for fish and crustaceans (WBM 2000). They are often used as indicators of environmental change due to their ubiquity, diversity and species turnover in aquatic environments. Benthic macroinvertebrates have low mobility and are therefore unable to move away from impacts therefore their community structure and composition can be indicative of eutrophic or polluted environments (e.g. Warwick 1986, 1993, Warwick and Clarke 1993 as cited in The Ecology Lab 2007).

Invertebrates are involved in virtually all major ecological processes, and are critical in maintaining functioning ecosystems (DSE VIC 2009). The Ecology Lab (2007) and WBM Oceanics (2001) reported that bivalve and gastropod molluscs and spionid (worm) polychaetes dominated the benthic fauna of Narrabeen Lagoon. These benthic macroinvertebrates and others are an important part of lagoon ecology for two reasons:

- Their burrowing and feeding activities rework and oxygenate the sediment; this process probably changes the nature of nutrients in the sediment.
- They are a significant food source for birds and fish.

In 2007 The Ecology Lab found that the abundance of macrobenthic fauna was weakly correlated with a combination of total organic carbon, phosphorus, lead and nickel that was found in the lagoon sediment. Dye and Barros (2005) and Dye (2006a) compared macrobenthic communities in closed lagoons with those from open lagoons, including Narrabeen (*cited in* The Ecology Lab 2007). They found that communities which were isolated from the sea, either by closure or distance from the mouth, exhibited lower diversity and a tendency for a small number of taxa to be numerically dominant. The Ecology Lab concluded that structure of these communities was a reflection of increased environmental stress characteristic of isolated localities (The Ecology Lab 2007).

The majority of animals in the lagoon are likely to be invertebrates. A key issue is that much of the existing information on the benthic fauna of Narrabeen Lagoon excludes a large proportion of the community due to the large sieve sizes used in some studies, potentially biasing conclusions.

As well as a lack of data on the benthic community of Narrabeen Lagoon, there is a lack of data with adequate spatial and temporal replication to allow patterns of community structure and condition to be interpreted (The Ecology Lab 2007). Knowledge of the benthic macroinvertebrate community could assist decision-makers in understanding the patterns and processes likely to affect the condition of the lagoon. It is possible that some benthic macroinvertebrates may represent keystone species as their presence and abundance could influence the types and numbers of other higher taxa, such as birds and fish (Paine 1995). In managing the lagoon, further information on the likely response(s) of benthic macroinvertebrates to natural and human-induced environmental change needs to be evaluated where appropriate.

Fish

Seagrass meadows are assumed to provide shelter and food for fish and are generally considered nurseries for many fish species. Across the lagoon, fish were most abundant in the central and western basins, and least abundant in the eastern channel (WBM 2001). However, the species diversity across the lagoon was fairly even (15 species in the eastern channel, 13 in the central basin and 12 species in the western basin). Fish abundance has recently been found to be higher in shallower areas of the lagoon than the dredge holes (BMT WBM 2009) indicating that shallower areas, including those with seagrass meadows, provide more favourable habitat.

In 2009 BMT WBM recorded the Hairy Pipefish (*Urocampus carinirostris*) in a fish survey of Narrabeen Lagoon. This species is listed as protected under the *FM Act* and is also a listed marine species under the *EPBC Act*. Any activities that may adversely affect the viability of this species in

the lagoon should be carefully managed. Key habitats for *U. carinirostris* are the lower reaches of rivers and estuaries or other protected inshore habitats where it was found in seagrass (*Zostera*) beds (Kuitert 2009). Cardno (2010) reported collecting this species in the eelgrass near the entrance to Middle Creek within the study area.

A key issue for the management of fish in the lagoon is that little is known of the abundance and diversity of species that occur there. This means that seasonality, spawning cycles and environmental condition including the condition of the lagoon entrance cannot be easily considered. Indeed, until fish surveys undertaken for WBM's report in 2009, no listed species had been recorded in the lagoon.

Threatened Aquatic and Estuarine Species

Forty-seven threatened fauna species listed under the *TSC Act* have been recorded in the locality of the study area (within five kilometres). Of these, a number are considered to utilise the aquatic and estuarine environment of the lagoon. Smith and Smith (2009) found that species known or considered likely to utilise waterside vegetation and mudflats habitat included: Australian Bittern; Great Knot; Broad-billed Sandpiper; Black-tailed Godwit; Terek Sandpiper; Greater Sand Plover; Lesser Sand Plover; Little Tern; Bush Stone-curlew; Beach Stone-curlew; and Pied Oystercatcher. Most of these species may only occur in the study area as occasional visitors or rare vagrants outside their normal range (Smith and Smith 2009). More detailed information on these species is included in the Due Diligence and Values Issues and Options Paper prepared as pre-cursors to this Plan (SMEC 2010:2011).

Migratory and Marine Species listed under the EPBC Act

A number of migratory species listed under the *EPBC Act* have been recorded in and around Narrabeen Lagoon. These species are also listed on various international agreements such as the Japan-Australia Migratory Bird Agreement and the China- Australia Migratory Bird Agreement.

Four species have recently been recorded in bird surveys at the Lagoon (Smith and Smith 2009). The species include: Osprey (*Pandion haliaetus*) (also listed under the *TSC Act*); Great Egret (*Ardea alba*); White-bellied Sea-Eagle (*Haliaeetus leucogaster*); and Caspian Tern (*Sterna caspia*). These migratory species utilise coastal areas including coastal lagoons for foraging, breeding and nesting habitat. Narrabeen Lagoon provides suitable foraging habitat for these species as they all feed on fish and some also feed on frogs and invertebrates in shallow water and foreshore vegetation. Only the Osprey is considered to have nesting habitat at Narrabeen Lagoon with a successful nest site being located between Middle Creek and Wakehurst Parkway (Smith and Smith 2008 in Smith and Smith 2009). A pair of Osprey have nested here for five consecutive years however not all years have resulted in successful breeding of an offspring (Cox 2008 and Cox 2009 in Smith and Smith 2009).

3.2.1.3 Exotic and Pest Species

The primary threat to the aquatic system of the lagoon, is the potential invasion of *Caulerpa taxifolia*, an aquatic weed is recorded in the Pittwater and Brisbane Water estuaries, but has not been recorded in Narrabeen Lagoon. *C. taxifolia* is an introduced aquarium pest that can adversely affect marine biodiversity by quickly colonising native seagrass beds. While ongoing research is looking into ways of eradicating this marine pest, anchoring and commercial and recreational netting are likely to be responsible for its spread around the Sydney region.

If detected in the future, management would be in line with recommendations from the Sydney Coastal Councils Group's *Caulerpa taxifolia* Taskforce. One of the components of the management of the lagoon is to promote seagrass bed health (Section 4), this would aid in the prevention of the establishment of this weed.

3.2.2 Water Quality

Water quality in the lagoon ranges from good at the entrance (due to effective tidal flushing) to poor in the western basin with elevated concentrations of nutrients and algae (WBM 2000). Water quality in the lagoon, particularly the central and western basins, is dominated by the quality of catchment runoff and tidal flushing in these sections of the lagoon is very poor. Typical flushing times are more than 90 days. As such, the lagoon has 'low pollutant assimilation capacity' (WBM 2000).

The water quality of the lagoon is impacted by a number of factors including catchment runoff events and the marine-dominated lower entrance channel area. The tributaries of the lagoon are most responsive to catchment runoff, followed by the western basin, the central basin and then the eastern channel. Depending on the volume of catchment runoff, the entire western basin can become fresh and the central basin can also experience fresh to brackish conditions. Rate of recovery back to full oceanic conditions is generally slow (WBM Oceanics Australia 2000).

During and immediately after catchment runoff events, the lagoon is dominated by freshwater. Salinity is low, pH is neutral and the water temperature is generally cooler (WBM Oceanics Australia 2000). Higher turbidity is also associated with such events due to stirring of the bed sediments, as well as suspension of fine sediment washed off the catchment. Development around many coastal lakes and their catchments, such as Narrabeen Lagoon, increases pollutant loads and modifies natural processes, resulting in degradation of the ICOLL and its tributaries. This is because ICOLLs typically act as nutrient sinks and internal processing and cycling can subsequently lead to algal blooms, even after inputs cease (WBM Oceanics Australia 2000). It is recommended that the Reserve Trust Manager work with Warringah Council to promote planning controls that minimise development in the lagoon catchment that will impact water quality of the lagoon.

Generally, an open entrance leads to better water quality through tidal flushing and increased oxygen levels while a closed entrance leads to eutrophication (WBM 2000). A closed entrance can lead to eutrophication through nutrient accumulation which supports dense algal growth and other organisms, the decay of which depletes shallow waters of oxygen in summer. This process has the potential to make the lagoon unsafe recreationally (Lugg 1996 *in* WBM 2000).

3.2.3 Tributaries

As previously noted, there are five tributaries that flow into Narrabeen Lagoon, i.e. Deep, Middle, Mullet, Nareen and South Creeks (**Figure 7**). These are subject to tidal flows and water quality is influenced by the quality of the water in the lagoon area. In the non-tidal sections of these tributaries the water is fresh (i.e. zero salinity), with variable dissolved oxygen and nutrient levels (WBM Oceanics Australia 2000).

Data collected to date shows that of all the creeks, Mullet Creek is the most degraded as it has recorded the highest faecal coliform counts and lowest oxygen concentrations. South Creek also has relatively high nutrient concentrations, as well as low dissolved oxygen and high faecal coliforms. Middle Creek contains moderate levels of nutrients while nutrient levels in Deep Creek are comparatively low; possibly reflecting the lower proportion of urbanisation of this part of the catchment (MWH Australia Pty Ltd 2004).

Faecal coliforms are higher in all of the tributaries but are generally low within the lagoon. In significant runoff events, the capacity of the lagoon to assimilate pollutant loads is limited. This can result in unacceptable bacterial conditions in the lagoon that can require the lagoon to be closed to the public (MWH 2004).

The poorest water quality was consistently in the tributaries to the lagoon, particularly Mullet and Narrabeen Creeks in Warriewood, and the freshwater sections of South Creek. These locations

were generally characterised by low dissolved oxygen, high nutrients and frequently high faecal coliform counts (MWH 2004).

3.2.4 Stormwater

Stormwater discharges typically increase flows into Narrabeen Lagoon. It typically contains a range of pollutants, including but not limited to sediment, nutrients (nitrogen and phosphorus), total petroleum hydrocarbons and debris. WBM Oceanics Australia (2001) recorded 42 stormwater drainage pipes that discharge into Narrabeen Lagoon. Many of these outlets (21) are along the estuary channel of the lagoon, four pipe outlets are at or close to the lagoon entrance, and the remainder are around the central basin. Thirteen of the 42 storm water drainage outlets have Stormwater Quality Improvement Devices (SQUIDS) that are designed to improve the stormwater quality inputs into the lagoon. The SQUIDS comprise litter booms, tidal flaps, sediment basins or, in the case of one stormwater outlet, a combination of litter and sediment basins.

The Northern Beaches Stormwater Management Plan provides a framework for the management of stormwater throughout Manly, Pittwater and Warringah LGAs. This Plan includes reference to this document as clause 76 of the Warringah LEP 2000 requires proposed water quality control measures to be provided in accordance with the Stormwater Management Plan. High priority applicable actions from the Stormwater Plan include: maintaining existing treatment measures, partnerships with other stakeholders such as Sydney Water, and enhancing an integrated strategy of community education and awareness (Patterson Britton and Partners 1999).

The main constituents of concern of stormwater discharge are nitrogen, phosphorus and suspended solids. WBM Oceanics Australia (2001) modeled the potential stormwater discharges under 'average', 'dry' and 'wet' climate conditions for the current level of development around Narrabeen Lagoon. In all situations, Total Nitrogen and Total Phosphorus exceeded the ANZECC guidelines.

Total Suspended Solids or Total Dissolved Solids (TDS) were measured by WBM (2001). This measurement has no direct correlation with the ANZECC Guidelines as the guidelines measure turbidity (NTU). Turbidity is not a very useful indicator in estuarine and marine waters (ANZECC 2000). Light attenuation is considered a more appropriate measurement for coastal lagoons (ANZECC 2000) and future water quality of the lagoon should measure this instead of TDS or NTU.

Pollutants in stormwater discharge are a threat for aquatic systems as they influence the water quality of the lagoon. However, there is no existing information evaluating the change in water quality following stormwater events and how long the stormwater persists in the lagoon. Therefore, the degree of environmental change in the lagoon and the implications for human health following storm events needs consideration.

3.2.5 Beachwatch

The NSW Beachwatch program monitors the recreational water quality at swimming beaches in NSW. While not an assessment of overall water quality, the results provide an indication of sewage and stormwater pollution, which affects the fitness of water bodies for human recreational use as well as the effectiveness of stormwater management (DECCW 2009).

Beachwatch provides the community with information on the risks of sewage and stormwater pollution at beaches. Two bacterial indicators – faecal coliforms (also called thermotolerant coliforms) and enterococci – are used to assess recreational water quality, in accordance with the National Health and Medical Research Council swimming guidelines (NHMRC 1990).

Beachwatch monitoring occurs in the lagoon at Birdwood Park, near the entrance during summer. This site was rated as poor for the period 2009-2010 (DECCW 2011). Microbial water quality is

generally good during dry weather, with elevated enterococci levels being measured during wet weather conditions. Swimming should be avoided after rainfall and when the entrance is closed.

3.2.6 Sydney Water

Sydney Water provides notification of wastewater overflow and bypasses for the Greater Sydney Region, which generally occur during wet weather and have the potential to impact on the water quality of Narrabeen Lagoon. The Reserve Trust Manager should monitor any such overflows or bypasses that might impact on Narrabeen Lagoon (as reported by Sydney Water or OEH).

3.2.7 Terrestrial Environment

3.2.7.1 Flora

The study area for the Plan contains a limited amount of terrestrial vegetation; namely that on two islands within the lagoon, an unnamed island and Wimbledon Island. Both islands are covered by EECs, being Swamp Oak Floodplain Forest and Coastal Saltmarsh. The exotic Norfolk Island Hibiscus (*Lagunaria patersonii*) is a common species on Wimbledon Island.

The majority of terrestrial vegetation in the surrounding area is the endangered Swamp Oak Floodplain Forest. Swamp Sclerophyll Forest on Coastal Floodplains is also present over a smaller area. In the Swamp Oak Floodplain Forest community, Swamp She-oak (*Casuarina glauca*) is the dominant canopy species, however, scattered individuals of Cabbage Tree Palm (*Livistona australis*), Cheese Tree (*Glochidion ferdinandi*) and *Melaleuca linariifolia* also occur (WBM Oceanics Australia 2001).

The shrub layer in the Swamp Oak Floodplain Forest is generally absent except in areas where the tree layer is sparse or absent (e.g. regenerating areas) or near the mouths of creeks (WBM Oceanics Australia 2001). The shrubs consist mostly of regenerating canopy species but also include exotic species such as Ochna (*Ochna serrulata*) and Lantana (*Lantana camara*) (occasionally in thickets) and a variety of horticultural species near parks and gardens. Native species other than canopy species occur mostly near the creek mouths, and include species such as *Pittosporum revolutum* and Coffee Bush (*Breynia oblongifolia*) (WBM Oceanics Australia 2001).

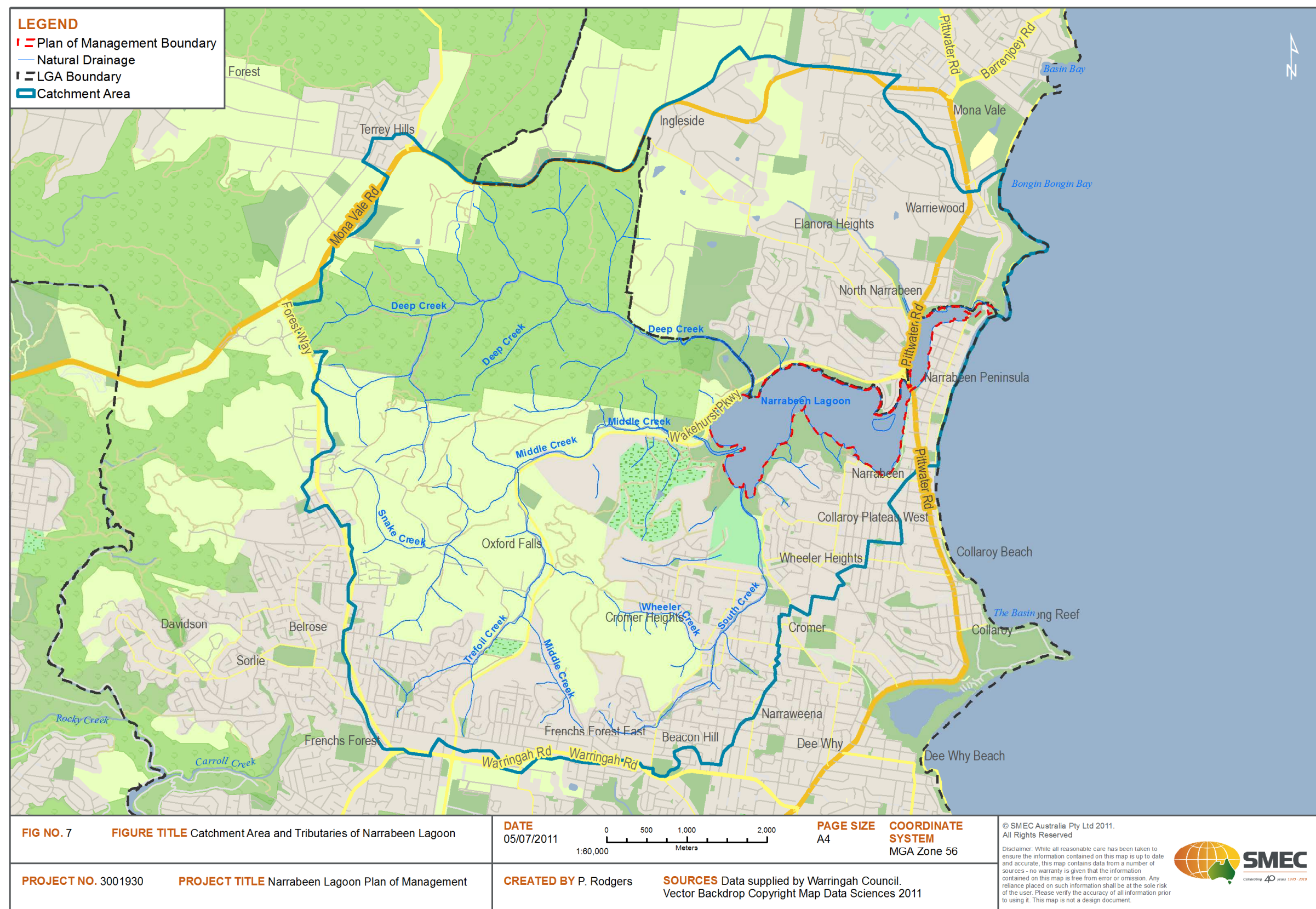
No EECs within the study area are listed under the *EPBC Act*. The location of all EECs as listed under the *TSC Act* around Narrabeen Lagoon (including a 100 metre buffer around the study area) is shown in **Figure 8**.

No threatened terrestrial flora species are recorded in the study area, however, four threatened species have been recorded within 500 metres of the study area. These are:

- Sand Spurge (*Chamaesyce psammogeton*).
- *Epacris purpurascens* var. *purpurascens*.
- Heart-leaved Stringybark (*Eucalyptus camfieldii*).
- *Pimelea curviflora* var. *curviflora*.

No ROTAP (Rare or Threatened Australian Plants) species have been recorded in recent surveys within the area of the Plan, however some have been recorded in the vicinity (Smith and Smith 2009; EcoLogical 2010).

Maintenance and management of the vegetation within the study area is an important component of the Plan of Management (**Section 4**). The vegetation on the islands is primarily maintained for ecological rather than recreational value.



3.2.7.2 Fauna

The lagoon and surrounding area is an important stopover for migratory birds and is home to one third of the bird species that are represented in Sydney (Warringah Council 2010a). A search of the Australian Atlas of Birds showed that 193 species have been recorded in the locality (Narrabeen Lagoon study area plus a one kilometre buffer) and 12 of these are listed under either *EPBC Act* or *TSC Act* as threatened. Many are waterbirds associated with coastal estuaries and wetlands or migratory species. A total of 272 fauna species have been recorded in the Narrabeen Lagoon catchment since 1990 (Harris *et al.* 2010).

The dominant terrestrial vegetation type, Swamp Oak Floodplain Forest, also provides potential foraging resources for many bird species especially the Glossy Black Cockatoo (*Calyptorhynchus lathamii*) and Yellow-tailed Black Cockatoo (*Calyptorhynchus funereus*) (Marchant and Higgins 1990).

Several species of common frogs (e.g. *Litoria peronii*, *L. phyllochroa* and *Crinia signifera*) are likely to utilise the upstream freshwater areas associated with the lagoon. In addition, the surrounding terrestrial habitats outside the study area are likely to provide an abundance of resources for many species of mammal such (e.g. possums, swamp wallabies, water rats and bandicoots).

Threatened Fauna

The Atlas of NSW Wildlife and Council's threatened species records show 44 threatened fauna species listed under the *TSC Act* within five kilometres of the study area. Ten of these are also listed as threatened under the *EPBC Act* with a further nine being migratory or overfly species under the *EPBC Act* (albatross, petrels and shearwaters were excluded from this list as they are considered marine and therefore unlikely to occur within the lagoon). Bird species comprise the majority of the listed fauna species recorded in the locality (Narrabeen Lagoon study area plus a one-kilometre buffer).

Two species were recorded as occurring within the study area (exact locations cannot be shown in public documents): the Powerful Owl (*Ninox strenua*), noting that there is a breeding pair in the study area, and Grey-Headed Flying Fox (*Pteropus poliocephalus*). A further 10 species were recorded within 500 metres of the study area that have potential to occur within the study area.

Several recent records exist for the following species:

- Glossy Black-Cockatoo (*Calyptorhynchus lathamii*).
- Black Bittern (*Ixobrychus flavicollis*).
- Osprey (*Pandion haliaetus*).
- Grey-headed Flying-fox (*Pteropus poliocephalus*).
- Rosenberg's Goanna (*Varanus rosenbergi*).

For example, an Osprey successfully fledged chicks close to the edge of the lagoon in 2007 and 2008, which is the southernmost example of breeding in this species in recent memory (Cox 2008 in Harris *et al.* 2010).

The future management of the study area is likely to influence the quality and quantity of available habitat for a number of the listed species above. As most of these species are highly mobile (such as birds, flying-fox and quoll) the study area may provide foraging, roosting and resting habitat as part of a larger home range.

Of particular concern within the study area are the Black Bittern and Osprey, both of which have been identified within study area and are likely to use the lagoon as foraging habitat. In addition, other threatened species such as the Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*),

Glossy Black Cockatoo and Grey Headed flying fox may use the Swamp Oak Floodplain Forest on the islands in the study area as foraging vegetation.

3.3 Recreation

3.3.1 Overview

Under the *CL Act* the purpose for Narrabeen Lagoon is Public Recreation and Coastal Environment Protection (except part of Wimbledon Island, refer **Section 1.2**). The challenge lies in determining the best means for protection and management of identified environmental values and hazards with respect to meeting the public recreational needs of the local community and people of NSW. Recreational pressures need to be balanced to conserve the unique natural values of Narrabeen Lagoon, which for many public recreational users, are the primary reason for visiting the area.

Narrabeen Lagoon is one of the most popular public recreational locations on Sydney's Northern Beaches (Warringah Council 2009). Narrabeen Lagoon is the only ICOLL in Sydney that allows primary contact recreational activities (such as swimming). Further, the recreational values of the lagoon are closely linked with environmental quality and significance of a place as well as the opportunities, activities and facilities available for public recreation and visitation (WBM Oceanics Australia 2002). Narrabeen Lagoon was the most used regional/major facility in Warringah according to a resident telephone survey undertaken in 2008 (WBM Oceanics Australia 2008) with 57 per cent of people surveyed using the lagoon. In 2002, approximately 1,400 people visited the lagoon each weekday, and up to 1,900 people on the weekend days (WBM Oceanics Australia 2002). It is likely that these numbers have increased since 2002 as the local population has increased.

Narrabeen Lagoon has been consistently used for public recreational purposes since the late 1800s. Recreational use of the lagoon has been documented through newspapers and photographs and through the establishment of clubs and organisations since the 1970s. One of the main impacts on recreation in a historical context has been the fluctuating water quality and depth of the lagoon throughout the last century. One of the main periods of poor water quality was in the 1960s and 1970s when septic overflow entered the lagoon during high rainfall. It was not until 1975 that the entrance of the lagoon was mechanically opened to aid in improved water quality, and until the late 1970s that an adequate sewerage system was completed for most of the households.

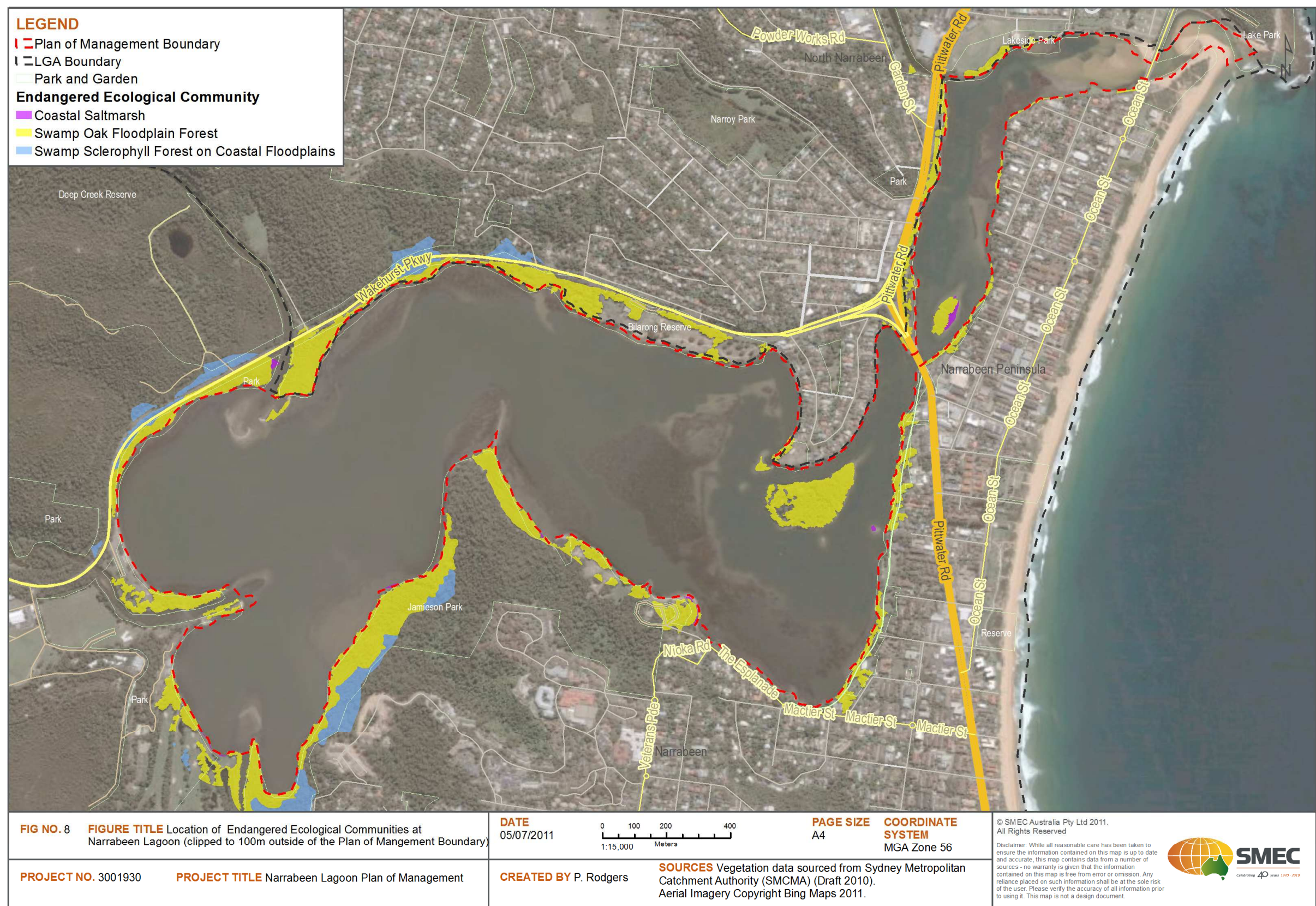


Figure 8: Extent of Endangered Ecological Communities at Narrabeen Lagoon

Within the catchment mechanical openings of the lagoon are undertaken primarily to protect low lying properties from flooding. This results in a lowering of the water level in the lagoon.

There are both direct impacts on the environment from public recreational activities that occur on the lagoon (water-based activities) and indirect impacts from public recreational activities occurring on the foreshore area of the lagoon (land-based activities). There is also the need to encourage sustainable and enjoyable use of the lagoon.

Consideration of the principles of ecologically sustainable development (ESD) is an important component of this Plan (**Section 4**) and must be addressed when assessing any activity on or near the lagoon. This may include use of a best practice management model to balance needs of public recreation and environmental protection.

3.3.2 Water-Based Activities

Water-based activities on the lagoon include:

- Sailing, catamaraning and windsurfing.
- Kayaking, canoeing, rowing and stand-up paddle-boarding.
- Boating.
- Model boating.
- Swimming.
- Recreational fishing and prawning.

The Estuary Processes Study of the lagoon which detailed consultation of recreational users of the lagoon carried out in 2000 (WBM Oceanics Australia 2001) found that kayaking was the single most popular recreational activity in Lagoons of Warringah LGA and approximately 2,400 users were estimated to partake in small, non-motorised paddling/windsurfing activity on the lagoons (kayaking, canoeing, windsurfing and rowing). Less than half of this number of users (880) was estimated for larger watercraft recreational activities (fishing from a boat, sailing, catamaraning and surf life saving (SLSC) activities) (WBM Oceanics Australia 2002).

Water-based activities and uses that have the highest risk of affecting the lagoon's ecology are those associated with boating (rowing/kayaking/canoeing/sailing). All of these have the potential to cause erosion to the banks of the lagoon through overuse of undesignated boat launch areas or makeshift boat ramps (WMB 2001). These activities may add to local sedimentation of the lagoon by destabilising the vegetation along the banks (WMB 2001).

The dedicated use of the lagoon and guiding principles of this Plan of Management lend themselves to the Reserve Trust Manager favouring more passive water-based recreational activities over the use of jet skis and powerboats on the lagoon. This would enable passive water-based recreational activities to be undertaken whilst having less of an impact on the environment and on other recreational users enjoying the amenity of the lagoon and its surrounds.

3.3.3 Land-Based Activities

Although the Plan refers only to the lagoon to the LTWL, land-based activities are considered here to give some background to the activities that must be managed on surrounding lands as they have the potential to impact on Narrabeen Lagoon. The Reserve Trust Manager will work with surrounding land managers to formulate appropriate guidelines and actions to manage appropriately the use of land in the surrounding area.

Recreational activities undertaken in open space areas surrounding the lagoon include:

- Picnicking.
- Cycling.
- Bushwalking/hiking.
- Walking/strolling/jogging.
- Bird watching.
- Shore fishing.
- General beach activities.
- Training activities for the Surf Life Saving Clubs.
- Dog training/dog walking.
- Golf.
- NSW Academy of Sport training.
- Coastal Education Centre and Community Centre activities.
- Scout activities.
- Community Markets (on the third Sunday of every month).
- Community Festivals.

Many of these activities are based around aesthetic appreciation and enjoyment of the lagoon; a key value that was identified through the community consultation process.

3.3.4 User Groups

The popularity of the lagoon for recreation has lead to the establishment of various community groups, clubs and commercial users. These user groups along with the nature of their recreational use (water-based or land-based) were identified in **Table 1**. It should be noted that there may be several more user groups of the lagoon.

Key user groups for water-based activities include:

- Manly Warringah Kayak Club (established in 1987).
- Sailing Club.
- Sydney Academy of Sports and Recreation.
- Coastal Environment Centre.
- Surf Life Saving Australia.

Table 1 Nature of the use of key clubs, associations and commercial businesses that utilise Narrabeen Lagoon for recreational activities

Name/Association/Company	Nature of Activity	Direct Water-based Activities	Direct Land-based Activities
Australian Bream Tournaments (ABT)	Fishing Competition	✓	✗
AROC Sport	Adventure Race	✓	✓
Blackheart Events	Adventure Race	✓	✓
Blowfish Café	Restaurant	✗	✓
Coastal Environment Centre	Education	✓	✓
Cromer Golf Club	Golf	✗	✓
Friends of Narrabeen Lagoon Catchment	Community group	✓	✓
Manly-Warringah Kayak Club	Kayaking	✓	✗
Palm Beach Water Sports	Windsurfing lessons	✓	✗
Prokayaks	Sales and hire of kayaks and canoes	✓	✓
Surf Life Saving Australia	Training activities	✓	✓
Sydney Academy of Sport and Recreation	Water sports	✓	✓
Scouts Association of Australia 1st Elanora Heights Scout Hall	Scouts	✓	✓
Suplove Stand Up Paddle School	Paddle boarding lessons	✓	✗
Narrabeen Lakes Festival	Festival	✗	✓
Narrabeen Lakes Sailing Club	Sailing and Windsurfing Club and School	✓	✗
Narrabeen Lagoon Catchment Festival	Festival	✗	✓
Narrabeen Village Market	Markets	✗	✓
UNSW Windsurfing Club	Windsurfing	✓	✗
Windsurfing NSW	Windsurfing lessons	✓	✗

3.4 Amenity

Elements such as landforms, vegetation, buildings and infrastructure contribute to the overall character of the landscape and influence how an area is experienced and valued by people (The Landscape Institute and IEMA, 2008). Feedback from the community has shown that visual amenity and the landscape character of Narrabeen Lagoon are particularly significant for residents and visitors. The natural and built environments may evoke sensory, cultural and spiritual responses and are likely to contribute substantially to the quality of life of users and nearby residents. Formal and informal lookouts within the area incorporate views of local bushland, water and the ocean, and are particularly important in contributing to the scenic and aesthetic quality of the area. Narrabeen Lagoon is a prominent landscape feature, and views of the water along the lagoon foreshores are particularly scenic.

Management actions outlined in **Section 4** provide for the maintenance of amenity and public safety particularly in relation to noise and pollutants to the environment of the lagoon.

Bushland is a highly valued recreational setting within the Warringah area. Various environmental programs are undertaken to remediate creeks and bushland and promote 'sustainable living'. The main community programs relevant to the care and management of Narrabeen Lagoon are:

- Creating a Sustainable Catchment. This program was formed from a NSW Environmental Trust Grant. The program promoted a catchment-wide sustainable living education program and on-ground works to improve creek bank stability and bush regeneration at Middle, Mullet and Nareen Creeks.
- Coastal Environment Centre. This centre runs education programs for the community on sustainable living and is particularly involved in providing programs on environmental sustainability for local schools.
- Friends of Narrabeen Lagoon Catchment. This group is a grass-roots community organisation concerned with education of the community about the environmental values and protection of Narrabeen Lagoon area. The group organises bushwalks and eco paddles and provides regular seminars and newsletters on the sustainable use of Narrabeen Lagoon catchment along with activities to increase awareness on issues surrounding the protection of the area (Harris *et al.* 2010).
- Friends of the Bush. The Friends of the Bush is a volunteer bush care program and is a successful partnership between the community and Warringah Council. The program is implemented in areas surrounding the lagoon to assist in the care and maintenance of terrestrial vegetation.

3.5 Heritage

3.5.1 Overview

The earliest known evidence of Aboriginal activity is 30,000 years ago in the Parramatta area (Jo MacDonald Cultural Heritage Management 2005). Evidence of Aboriginal activity in the Narrabeen Lagoon catchment is about 6,000 - 20,000 years ago (Harris *et al.* 2010) and the lagoon was first sighted by Captain Cook in 1770 (WBM 2000). Aboriginal populations in the area were virtually eliminated by smallpox from the late 1700s to 1833 (Harris *et al.* 2010). The first land grants to settlers were made in 1818 (**Figure 9**).

In 1880, the Narrabeen Lake Bridge was constructed and a causeway and narrow bridge were built at Pittwater Road in the early 1900s. At this time, residential development also commenced within the catchment.

Dredging of the lagoon was first carried out in 1911. Warringah Shire Council carried out dredging in the central basin in the 1950s and 1960s to create Jamieson Park and Bilarong Reserve.

Dredging ceased in the 1970s due to the restrictions imposed by the *Clean Waters Act 1970* (**Figure 9** provides more detail on the history of dredging and other activities).

3.5.2 Indigenous (Aboriginal) Heritage

Aboriginal heritage sites are part of a living culture. Many items, places and precincts may also be of heritage significance to Aboriginal people. Aboriginal heritage is not limited to relics but also includes burial sites, engraving sites, natural sacred sites or features, rock art and midden deposits. Aboriginal heritage includes places and items that are important to the local Aboriginal community or to Aboriginal people of NSW (Heritage Branch, accessed online 28 September 2010).

A search of Council's GIS undertaken by Warringah Council's Development Assessment Officer (Heritage Advisor) indicated that there are approximately 30 Aboriginal sites recorded in the vicinity of the study area at least 250 metres from the lagoon. Due to the sensitive nature of the sites their locations are not detailed in this Plan. No items on the Commonwealth Heritage List have been identified within the study area and surrounds.

Aboriginal heritage sites (including shell middens and camp sites, and also burials) are commonly found in association with lagoons, estuaries and the coastline. Further, large lakes/lagoons often have cultural value to Aboriginal people. Hence it is considered, and shown in Council's GIS, that the study area and its surrounds have an 'extremely high' potential to yield Aboriginal heritage although it is likely that much of the immediate lagoon perimeter has been subject to more recent land modification and disturbance reducing the archaeological potential.

3.5.3 Non-Indigenous Heritage

Items of non-Indigenous heritage are listed under the NSW *Heritage Act 1977*, *EPBC Act* and the *EP&A Act* (under LEPs), REPs, SEPPs and the National Trust may also identify items of non-Indigenous heritage value. These are listed in point form below and include items of built heritage, historical archaeology, movable heritage, cultural heritage and landscapes.

- The Narrabeen Lake Bridge, located on Pittwater Road, is a non-Indigenous heritage item, listed under Section 170 of the NSW State agency heritage register. Today, the bridge forms a landmark in the Narrabeen landscape and is readily viewed and interpreted from the surrounding, well patronised recreational areas (NSW Heritage Register 2005).
- The Never Been Beaten Lime and Cement Works Ruin at Deep Creek (listed under Council's Heritage Inventory) which occurs directly adjacent to the study area.
- Remnants of a stone jetty (associated with the ruins of Wheeler Homestead) occur on the southern section of the lagoon about 100 metres from James Wheeler Place. This heritage item is listed under the Council's Heritage Inventory and is considered to be of local heritage significance.

Several other heritage items are within 500 metres of the study area including Cabbage Tree Palms (listed as remnant vegetation) at Malcolm and Lagoon Streets (SMEC Australia Pty Ltd 2010) and Bridge Number 3 over Middle Creek. **Figure 10** shows the location of listed non-Indigenous heritage items.

Historical Timeline of Narrabeen Lagoon and its surrounding Land Use

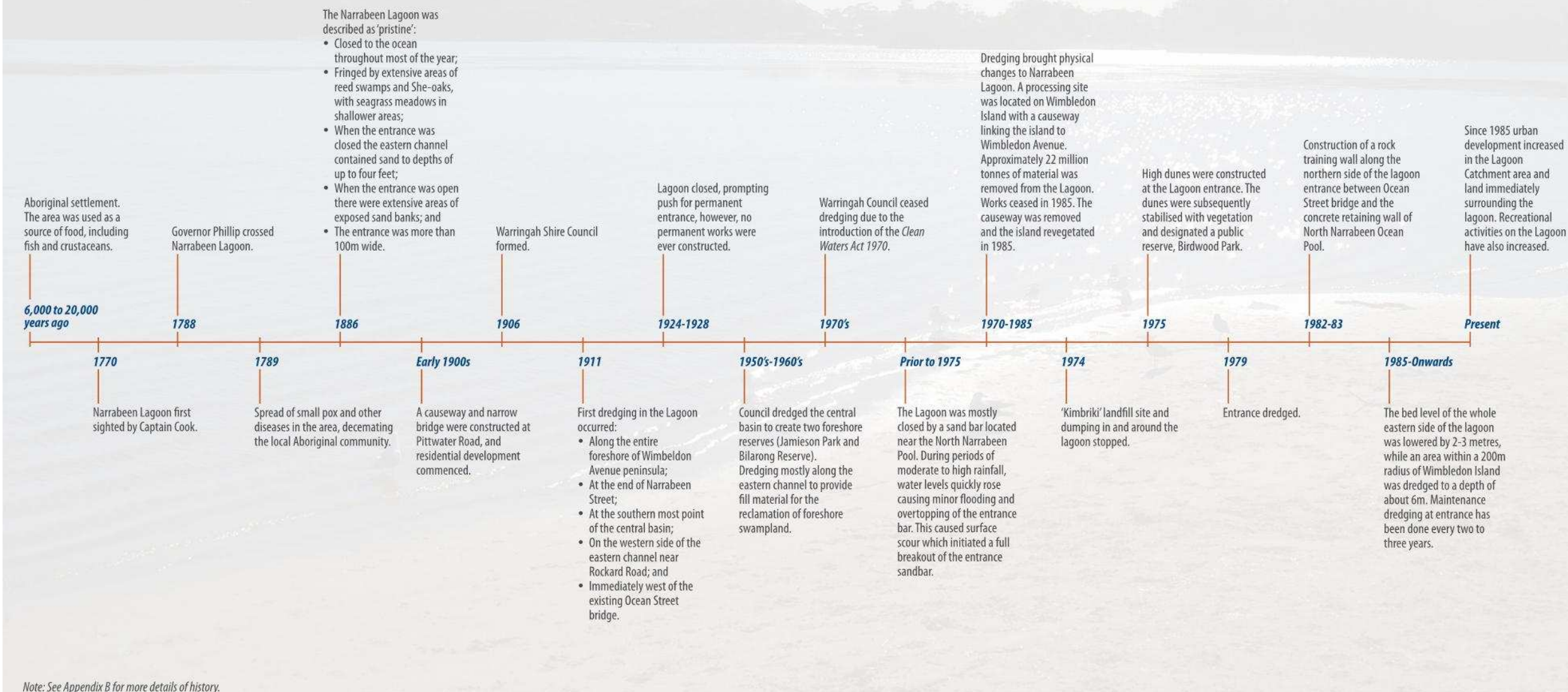


Figure 9: Historical Timeline of Narrabeen Lagoon

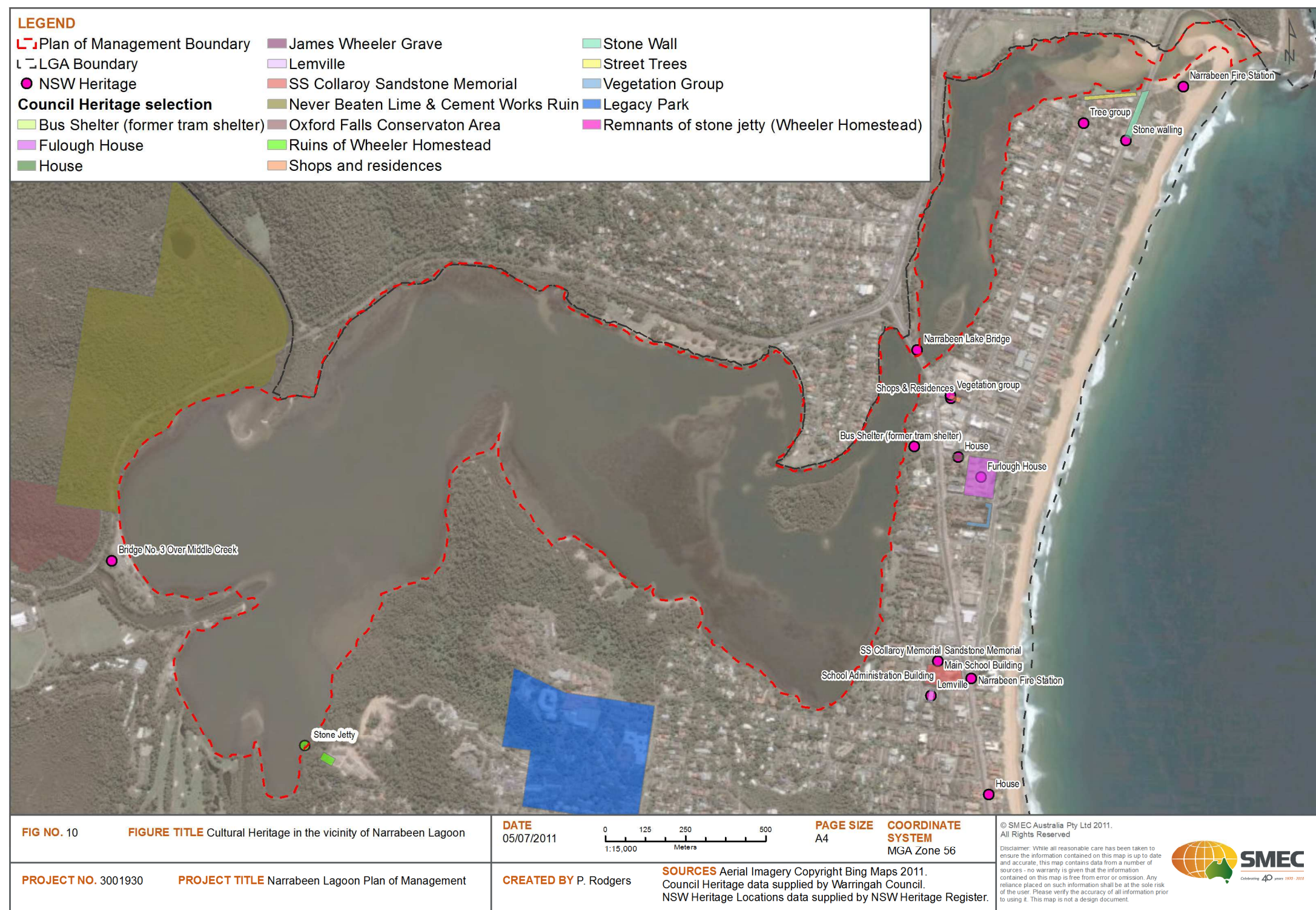


Figure 10: Non- Indigenous heritage of Narrabeen Lagoon and surrounding area

3.5.4 Natural Heritage

The environmental heritage of NSW includes components of the living and non-living environment. It consists of natural heritage such as land resources, marine, estuarine and inland waters and diverse animal and plant life, and cultural heritage, reflected in the evidence of human occupation and settlement (NSW Heritage Office 2000).

Heritage significance includes items of scientific, cultural, natural or aesthetic value (*Heritage Act 1977*; detailed in Chapter 2). As such, items of natural heritage are listed under this Act as well as the *EPBC Act*. A search of the NSW State Heritage Inventory (via the Heritage Branch website) and the Council's Heritage Inventory show that the study area does not contain any listed items of natural heritage significance. The areas immediately surrounding the lagoon, however, have numerous listed natural heritage items including Ku-ring-gai Chase and Garigal National Park, Beacon Hill and Governor Phillip Lookout Reserves, Long Reef and Barrenjoey Coastal Rocks, Long Reef Aquatic Reserve, and Dee Why Lagoon Reserve.

Although not formally listed, Narrabeen Lagoon itself is of high cultural value within the Warringah area and is one of the areas greatest natural assets (Warringah Council 2010a).

3.6 Flood Mitigation

Flooding in Narrabeen Lagoon is the result of a combination of the effects of storm surge (including barometric and wind setup), wave setup at the lagoon entrance, extreme rainfall and level of the entrance berm. These variables are not statistically independent, but the correlation between them is poorly understood. Flooding of the low-lying areas surrounding the lagoon was identified in the Narrabeen Lagoon Flood Study (NSW Public Works 1990) and can be the result of the entrance conditions and rainfall within the catchment area, with the following three scenarios impacting on flood levels:

- Lagoon entrance closed, combined with heavy rain.
- Lagoon entrance open, combined with ocean level rise.
- Lagoon entrance open, combined with heavy rain.

Council in partnership with Pittwater Council currently manages the entrance through the Warringah Council Narrabeen Lagoon Entrance Management Operational Management Standard, which specifies conditions for initiating lagoon breakout and lagoon entrance clearance (through ongoing monitoring via the Lagoon Watch system).

Heavy rain in the Narrabeen Lagoon tributaries can result in flooding of the low-lying areas of the lagoon floodplain (SMEC Australia Pty Ltd 2003). As such heavy rainfall into the lagoon can increase sediment and nutrient inputs into the lagoon, however, the outcomes of flooding events and the rate at which the lagoon water levels fall back to normal inundation are reliant on tides and the extent to which the entrance is open. Current climate change predictions for sea level rise and increased rainfall intensity may exacerbate the flood risk.

In January 2011, Pittwater and Warringah Councils endorsed respectively the Narrabeen Lagoon Floodplain Risk Management Working Group/Community Committee to provide a greater focus on completing flood risk management tasks. The group is jointly managed by the two councils, alternately on an annual basis, to meet quarterly. The Reserve Trust Manager will need to work closely with Pittwater and Warringah Councils through the Narrabeen Lagoon Floodplain Risk Management Working Group/Community Committee to address flood risk issues and implement the Entrance Management Program as part of its management strategy for the lagoon (refer **Section 4**).

Council is currently working closely with Pittwater Council to develop an updated Floodplain Risk Management Plan for Narrabeen Lagoon in accordance with the NSW *Floodplain Development Manual*.

3.6.1 Entrance Clearing

The entrance channel of Narrabeen Lagoon periodically closes through the natural movement of sand into the lagoon entrance. The condition under which this occurs is when the amount of sand moved into the entrance by the incoming tide exceeds the amount of sand carried out of the entrance by the outgoing tide (Cameron *et al.* 2008).

During periods when the entrance is open, the lagoon discharges to the Pacific Ocean from a narrow outlet. During periods when the entrance becomes infilled and closes, there is increased potential for flooding and reduced water quality in the lagoon. In a natural environment, the lagoon would flood and burst its banks creating an outlet for water flows. However, since the lagoon is in an urbanised environment this option is impractical and dredging the entrance is considered an appropriate action to abate flood risk and eutrophication.

Warringah and Pittwater Councils, with the assistance of the NSW Government under its Floodplain Management Program, periodically undertake entrance clearance operations in order to manage this dynamic system and reduce the risk of flooding (Warringah Council 2010b). As well as reducing flood risk, the aim of the entrance dredging works is to deepen the entrance opening to improve water flows through improved tidal flushing.

There are two types of clearance operations that are undertaken at the lagoon entrance: mechanical opening and entrance clearance. In accordance with its Entrance Management Policy, Warringah Council mechanically opens the lagoon entrance when the lagoon water level is at or exceeds 1.3 m AHD (Warringah Council 2002). Mechanical opening reduces the water level and the risk of properties being flooded.

Mechanical openings are a short term solution and do not remove the accumulation of marine sand upstream and downstream of the Ocean Street Bridge. The removal of this large 'sand plug' can only be undertaken via an Entrance Clearance Operation (Warringah Council 2010b). Entrance clearance operations are a major project cost to both Warringah and Pittwater Councils, and while they qualify for financial assistance under the NSW Government Floodplain Management Program, they nevertheless require sufficient budgetary allocations by both councils prior to the consideration of such operations (Warringah Council 2010b).

Numerous clearance operations were undertaken within the lagoon since the mid 1970s, with the last entrance clearance in 2006. Since 2006, the lagoon entrance has gradually become infilled with sand, with the entrance finally closing on 12 May 2009. It was opened mechanically on 29 May 2009, on 5 November 2010 and again on 20 March 2011 by Council due to rising water levels and the associated flood risk.

Dredging of the entrance to the lagoon occurs every three to four years and is subject to appropriate environmental assessment under Part 5 of the *EP&A Act*. The next entrance clearance operation is planned to be completed mid-2011 (Warringah Council 2010b). It is anticipated that on-ground works associated with the entrance clearance operation will be undertaken in June-July 2011.

There are a number of both short-term and long-term environmental impacts that can occur as a result of dredging the entrances of ICOLLs. According to Wiecek and Floyd (2007), the short-term effects on a system such as Narrabeen Lagoon could include:

- Increase in suspension of sediments that place an oxygen demand, resulting in anoxic events and potential marine life kills.
- Contaminants contained within sediments being released resulting in water quality and habitat toxicity problems.
- Removal of bottom-dwelling animals (benthos), reducing available food for dependant species and altering processes such as the nutrient cycle.

- Altering water circulation patterns, tidal passage and associated current strength disrupting aquatic communities, such as seagrass, through scouring or changing tidal exposure.

Accompanying these proposed short term effects are also some long term impacts:

- Reduced periods of prolonged flooding to surrounding wetlands and establishment of dry-land species resulting in a reduction of the wetland area.
- Existing foreshore communities such as saltmarsh, which may be threatened in the event of introduction and establishment of mangroves.
- A prolonged period of reduced water level and increased tidal exchange has the potential to impact on both aquatic and terrestrial flora and fauna species.

3.7 Infrastructure Associated With Narrabeen Lagoon

The parks and reserves that surround Narrabeen Lagoon have numerous facilities for both public and private use. These include barbeques, parking facilities, playground equipment, halls, water recreation clubs, boat ramps and a caravan park.

The only public infrastructure within the study area is several boat ramps. Other infrastructure necessary for recreational use of the lagoon is located outside of the lagoon and the Reserve Trust Manager will need to consult with surrounding land managers regarding the use and upkeep of this infrastructure. Management of boat ramp infrastructure, including access and maintenance, is included as part of the Plan in **Section 4**.

4 PLAN OF MANAGEMENT

4.1 Roles And Responsibilities

4.1.1 Reserve Trust

The Narrabeen Lagoon Reserve Trust has been established under the *CL Act* (gazetted in the NSW Government Gazette 18 March 2011). Warringah Council has been appointed as Reserve Trust Manager responsible for the care, control and management of Narrabeen Lagoon. All activities carried out on the lagoon must be consistent with the reserve purpose of Public Recreation and Coastal Environmental Protection. These two purposes drive the management actions of the lagoon. It should be noted that while one of the purposes is Coastal Environmental Protection, this applies only to the area of the lagoon, and not to the coastal beachside areas of Narrabeen.

4.1.2 Plan Review

For this Plan of Management to remain relevant, it will be essential that some degree of consistent review be carried out. The Plan has been set up in such a manner that the separate elements can be readily reviewed and updated on differing time intervals.

In line with the various sections of the Plan and in particular the headings in **Table 2**, it is recommended that the Plan be reviewed in the following sequence and time spans:

Every year:

- Review progress of Actions² and report as part of the Trust's Annual Report.
- Review Priorities.

Every five years:

- Review the Objectives.
- Review Performance targets and Performance measures.
- Review the Key Values³ (Section 3).
- Review the Statutory Controls that underpin the Plan (Section 1.6 Legislative Framework).

4.2 Management Strategy, Actions and Performance Targets

Section 4.3, Table 2 lists the management strategies⁴ for Narrabeen Lagoon, consistent with the purposes of the lagoon: Public Recreation and Coastal Environmental Protection. The table identifies key performance targets, performance indicators and priorities for actions associated with the protection and management of the key values of the lagoon.

The priorities of the values, strategies and actions have been guided by community feedback gathered by Straight Talk during the consultation process, input from DPI and Warringah Council. During this process, values, issues and options were identified by SMEC and Council and presented to the community for comment (see **Section 2** for further information). Generally, high priorities were assigned to values that gained group support during the second workshop (Straight Talk 2011). Translation of the most supported options into the values, strategies and actions is shown in **Appendix 2**. These community supported values and actions were reviewed and revised by Council, SMEC and DPI based on Council's current commitments and LGA wide strategies and

² The method for implementing a management strategy

³ Identified as an important aspect of Narrabeen Lagoon, by the community, Council, DPI or SMEC

⁴ A plan to preserve one of the values identified for Narrabeen Lagoon

plans e.g. Warringah Council Recreation Strategy (2009) and Warringah Council's Strategic Community Plans. Medium, low and ongoing priorities were based on values that garnered some community support or were considered necessary for the administration or day-to-day management of the lagoon by Council, SMEC and DPI.

4.3 Management Action Plan

Table 2 Management Strategy for Narrabeen Lagoon

Value ⁵	Strategy ⁶	Item ID	Action ⁷	Performance Target ⁸	Priority	Performance Measure ⁹
Objective: To establish water quality outcomes suitable for protection of the natural environment and for public recreation;						
Natural Environment (Aquatic Habitat)	Water quality management	EP1	Investigate current litter management to determine effectiveness. Investigate public education/enforcement campaigns to reduce littering. Work with adjacent landowners and Council to maintain or improve litter management systems and procedures wherever possible.	To reduce litter entering the lagoon.	High	Reduction of litter reaching the lagoon, (Potential for measurement by GPT clean out rates).
		EP2	Where necessary, investigate causes and ecological impacts of poor water quality. Work with adjacent land owners, Reserve Trusts, OEH, Sydney Water and Pittwater Council to minimise poor quality runoff discharging into the lagoon.	Maintain or improve water quality entering the lagoon by addressing issues of concern as identified especially with consideration of aquatic ecosystems.	High	Lagoon water quality is maintained or improved (e.g. Beachwatch data).
		EP3	Work with catchment managers to investigate level and cause of sedimentation in the lagoon and tributaries, address identified issues with landholders and residents within the catchment. Implement Northern Beaches Stormwater Management Plan as appropriate.	Prevent increased rates of sedimentation above natural levels.	Medium	Assess and report any known changes in quality and rate of sedimentation.

⁵ Value: Identified as an important aspect of Narrabeen Lagoon, by the community, Council, DPI or SMEC.

⁶ Strategy: A plan to preserve one of the values identified for Narrabeen Lagoon.

⁷ Objective: The purpose of goal of the management of Narrabeen Lagoon.

⁸ Performance Target: The ideal outcome of the action.

⁹ Performance Measure: How the action will be measured against a performance target.

Value ⁵	Strategy ⁶	Item ID	Action ⁷	Performance Target ⁸	Priority	Performance Measure ⁹
Objective: To maintain and enhance the Natural Environment						
Natural Environment (Aquatic Habitat)	Protection of aquatic habitat and fauna	EP4	Ensure satisfactory environmental assessments are undertaken for works and activities proposed within the bed of the lagoon. Such activities will only proceed if the negative impact on the environment is minimal or avoided and/or appropriate mitigation and offset measures are implemented.	Prevent negative impacts to the aquatic habitat resulting from works and activities.	Ongoing	Satisfactory environmental assessments are completed as required for works and activities within the bed of the lagoon. Mitigation and offset measures are implemented as appropriate.
	Understanding of Key Aquatic Habitat	EP5	Monitor and gather relevant information as it becomes available on the condition of key aquatic habitat to understand the status and condition of the lagoon as key fish habitat. Provide information to Council for use in determining DAs and other proposed activities.	Maintain and enhance aquatic habitat including key fish habitat such as seagrass and saltmarsh within the lagoon.	Ongoing	Information is gathered from any monitoring or data collection and reported in Annual Report.
	Protection of sea grass beds and saltmarsh EEC	EP6	In consultation with relevant agencies, investigate current methods and best practice for the long term sustainability of seagrass beds and coastal saltmarsh. Operational sub plan to include saltmarsh and sea grass protection.	Reduction in the loss, or preferably an increase of estuarine vegetation of Narrabeen Lagoon, especially seagrass beds and saltmarsh, outside of natural variation.	Ongoing	Assessment of extent, quality and biodiversity within sea grass beds and coastal saltmarsh.
	Maintain or improve depth of water in the lagoon for its environmental values	EP7	Where appropriate, change the water depth (e.g. by infilling or other method) in some areas of the lagoon's central or western sections to improve its environmental and habitat values.	Water depth appropriate for improved habitat value.	High	Assessment of biodiversity within affected areas.

Value ⁵	Strategy ⁶	Item ID	Action ⁷	Performance Target ⁸	Priority	Performance Measure ⁹
Objective: To promote and enhance unique environmental and amenity values of the lagoon						
Natural Environment (Aquatic Habitat and Terrestrial Habitat)	Lagoon as educational resource	EP8	Promote use of lagoon for educational purposes. Support community groups (especially schools) and other stakeholders in studying and learning about the lagoons environment. Link to existing programs with educational facilities.	Use of lagoon by groups for educational promotions and training including TAFE and research by universities and other interest groups. Programs established with educational facilities.	Medium	Improved understanding and appreciation of the environmental, social and recreational values of the lagoon.
	Community involvement	EP9	In conjunction with appropriate stakeholders, promote and manage effective improvements in protecting the environment of the lagoon and the catchment by all residents, volunteers and other interested groups. Development and distribution of appropriate media, including liaising with community groups.	Stakeholders and the community are active participants in protecting the environment of the lagoon.	Medium	Improved understanding and appreciation of the environmental, social and recreational values of the lagoon. Report progress in Annual Report.
Heritage	Protect and enhance heritage values	EP10	Manage heritage items in accordance with heritage listing under relevant legislation and policies.	Heritage items are maintained and preserved.	Ongoing	Preservation (no impact) of heritage items in the vicinity of the study area as a result of activities on the lagoon.

Value ⁵	Strategy ⁶	Item ID	Action ⁷	Performance Target ⁸	Priority	Performance Measure ⁹
Objective: Coastal Environmental Protection						
Natural Environment (Terrestrial Habitat)	Protection of terrestrial vegetation within the Plan area	EP11	Investigate condition and confirm classification of terrestrial vegetation within the Plan area (including island and foreshore vegetation) including endangered ecological communities (Saltmarsh and Swamp Oak Floodplain Forest). If appropriate undertake regeneration. Work with Councils, Friends of the Bush and other groups for rehabilitation works required.	Classification and condition of EEC's within the Plan area are confirmed. Identified areas of EEC are maintained and improved.	Medium	Areas and condition of EEC are assessed and recorded.
Natural Environment (Aquatic and Terrestrial Habitat)	Protection of study area from over development subsequently reducing impacts to the lagoon	EP12	Promote appropriate development and planning controls through liaison with adjacent land managers that ensures impacts on the environmental values of the lagoon are avoided or minimised.	Impacts to the natural environment of Narrabeen Lagoon from development are avoided or minimised through local development and planning controls.	Ongoing	Approved development in the catchment does not impact on the reserved purpose of Narrabeen Lagoon (public recreation and coastal environmental protection).

Value ⁵	Strategy ⁶	Item ID	Action ⁷	Performance Target ⁸	Priority	Performance Measure ⁹
Objective: Sustainable, diverse and appropriate use of the area for recreation						
Recreation	Sustainable public recreation	PR1	Work with Warringah Council and relevant stakeholders to facilitate holistic approach to management of public recreation on the lagoon to allow use and enjoyment of the lagoon while avoiding/minimising environmental impacts. Specific management model for Narrabeen Lagoon to be developed as part of Warringah Council Recreation Strategy 2009 (Action 20).	Sustainable public recreation on the lagoon.	High	Implementation of this model by Warringah Council by the end of 2013. Reserve Trust Manager to document progress in annual report.
		PR2	Work with NSW Maritime to enforce restrictions on boating where safety and/or environmental issues need to be managed including increased surveillance and enforcement (if agreed upon all parties). Regular liaison between Reserve Trust Manager, NSW Maritime, DPI and Pittwater Council.	Safety and/or environmental issues relating to boating are avoided or minimised.	High	Reduction in number of incidents reported in the NSW Maritime annual report.
		PR3	Investigate use of watercraft during peak periods and determine appropriate measures to adequately manage use of water craft.	Appropriate use of watercraft within the lagoon.	Medium	Appropriate rules in place for watercraft management, and adherence to these rules.
	Water quality appropriate for swimming	PR4	Utilise existing water quality data from Beachwatch and Sydney Water and investigate adequacy of knowledge of current water quality within the lagoon. Obtain appropriate level of data on water quality for swimming.	Water quality in the lagoon appropriate for swimming.	High	Facilitate public access to water quality data.

Value ⁵	Strategy ⁶	Item ID	Action ⁷	Performance Target ⁸	Priority	Performance Measure ⁹
	Maintain or improve depth of water in the lagoon for recreational access without compromising its environmental values	PR5	Where appropriate, change the water depth (e.g. by dredging or other method) in some areas of the lagoon's central or western sections to improve recreational access without significantly affecting its environmental values.	Water depth is appropriate for recreation without significantly affecting the environmental values of the lagoon.	High	Bed of lagoon is at an appropriate level for sustainable recreational access and environmental values are not compromised.
	Appropriate and well maintained facilities to support recreation and maintain and improve safety for users	PR6	Maintain and upgrade appropriate facilities such as car parks, boat ramps and wash down areas. Work with adjacent land holders in undertaking these works.	Appropriate and accessible facilities are provided to maintain sustainable recreation on the lagoon.	Ongoing	Appropriate facilities are provided. Document maintenance of and provision of new facilities.
	Protection of amenity	PR 7	Include protection of amenity and peace of area as important consideration during implementation of all other management strategies. Specific management model for Narrabeen Lagoon (see PR1) to consider impacts of recreation on amenity and peace of area.	Maintain or improve amenity and peace of the area for all users.	Ongoing	Implementation of the management model by Warringah Council by the end of 2013. The amenity and peace of the area are maintained and not impacted.
	Public education	PR 8	Work with stakeholders to educate the community on the sustainable use of the lagoon (e.g. fishing size limits and appropriate disposal of litter). Resources are made available to the community, relating to the sustainable use of the lagoon. DPI to enforce license permits and fish catch size limits). Increased presence and enforcement by DPI as appropriate.	Sustainable use of the lagoon by the community.	Ongoing	Improved community perceptions of the lagoon, and improved environmental indicators.

Value ⁵	Strategy ⁶	Item ID	Action ⁷	Performance Target ⁸	Priority	Performance Measure ⁹
Objective: To manage potential impacts of flooding on commercial and residential properties as identified in an adopted Flood Risk Management Plan						
Flood Mitigation	Flood mitigation for protection of homes and businesses in surrounding areas	PR9	Use data and recommendations from adopted Floodplain Risk Management Plans for Narrabeen Lagoon to manage flood risk. Review actions of this Plan upon reviews of the Narrabeen Lagoon Flood Study, Flood Risk Management Strategy and Flood Risk Management Plan. Update where appropriate in response to findings of the study.	Flood risk managed appropriately.	High	Implementation of adopted Floodplain Risk Management Plans for Narrabeen Lagoon and report on flood information in annual reports.
		PR10	Assess entrance management regimes in conjunction with Warringah and Pittwater Councils and the community to ensure the most efficient and effective management of this area is maintained. Undertake review of effectiveness and impacts of entrance management procedures is undertaken, in consultation with Warringah and Pittwater Councils and the community.	Appropriate entrance management regimes are implemented.	Ongoing	Appropriate review of entrance management procedures is undertaken and the most efficient and effective management of this area is implemented. Report on the activities, assessments and reviews undertaken.
		PR11	Management of flood risk to commercial operations and private property including provision of flood risk information to prospective commercial operators and the public and set plans in place.	Appropriate management of flood risk to commercial operations and private property.	Ongoing	Production of and reporting on flood awareness and planning material.

Value ⁵	Strategy ⁶	Item ID	Action ⁷	Performance Target ⁸	Priority	Performance Measure ⁹
Objective: Effective administration for implementing strategies						
All	Annual reporting	Admin 1	Annual report prepared for Narrabeen Lagoon and submitted to DPI. Report to be publicly available on Warringah Council website.	Prepare and make public a Trust report for Narrabeen Lagoon on an annual basis.	Ongoing	Annual report meets statutory requirements and provides information to DPI, stakeholders and the community
	Appropriately gazetted purpose	Admin 2	All areas of the lagoon to include 'Coastal Environmental Protection' as a reserve purpose under the <i>CL Act</i> .	Purpose of Narrabeen Lagoon reflects current value of Crown Reserve land by stakeholders.	High	Public purpose of dedications amended to include 'Coastal Environmental Protection'.
	Integrated management of local Crown reserves	Admin 3	Investigate the merits of the amalgamation of Narrabeen Lagoon and one or more areas or surrounding Crown land reserves into a State Park.	Optimal management of Narrabeen Lagoon and other Crown lands in the catchment.	Medium	Investigation into the merits of State Park is undertaken. Annual report to include a section on the status of this investigation.
	Approval of leases and licenses by Reserve Trust Manager	Admin 4	Investigate if it would be beneficial for the management of Narrabeen Lagoon for the Reserve Trust Manager to be authorised to grant leases and licenses by the Minister administering the <i>CL Act</i> .	Determination and documentation of costs and benefits for Reserve Trust Manager in being able to determine leases/licenses.	Low	Investigation into the management of leases/licences is undertaken. Annual report to include information on this investigation.
	Sustainable Financial Management of Reserve Trust	Admin 5	Develop a financial management model for implementation by the Reserve Trust Manager.	Narrabeen Lagoon is effectively managed by income generated on and by the lagoon and from external sources (including grants).	High	A financial management model is developed and finances are audited under standard Council financial accounting procedures.

Value ⁵	Strategy ⁶	Item ID	Action ⁷	Performance Target ⁸	Priority	Performance Measure ⁹
	Rationalise reserve boundaries for Narrabeen Lagoon Reserve Trust Management Lands	Admin 6	Investigate undertaking redefinition surveys with respect to boundaries.	Relevant land reserves are rationalised and final title plans are revised and re-registered with the LPI.	High	Lodgement and registration of amended title plans with the LPI.

4.4 Implementation

4.4.1 Commercial Management

Use of Crown reserves for commercial activities is authorised under the *CL Act*, provided that they are consistent with and ancillary to the public purposes of the land which in the case of Narrabeen Lagoon is Coastal Environmental Protection and Public Recreation.

Identification of acceptable land uses, including whether a commercial activity is acceptable, is undertaken by one of three mechanisms:

1. Identification of acceptable uses within the scope of public purpose nominated for the reserve under the *CL Act*.
2. Identification of the uses that are permissible under the relevant environmental planning instruments made under the *Environmental Planning and Assessment Act 1979*.
3. Identification of the uses indicated for the reserve in a plan of management under the *CL Act* (Dept of Lands 2004).

Generally, food and beverage outlets are not considered appropriate for reserves with the nominated public purpose of “environmental protection”. No direction is given for reserves that are nominated as “Public Recreation and Coastal Environmental Protection” (Dept of Lands 2004), however it is likely that this extends to this purpose also and therefore such commercial activities would not be appropriate for the bed of the lagoon or the islands contained within.

Other commercial activities may be acceptable, if they meet the following criteria:

- The facility should enhance the public use of the reserve and not become the main focus of the reserve.
- The integrity of the reserve in terms of its public purpose and environmental qualities should be preserved.
- The public’s right to access should be preserved.

It is proposed to assess each application for commercial licensing on its merits, taking into account the above considerations. Further information on leasing and licensing is provided in

Section 4.2.2.

In order for the Reserve Trust Manager to be financially sustainable, a sustainable income model for the management of Narrabeen Lagoon should be developed and this is an action for this Plan.

4.4.2 Leases and Licenses

Leasing or licensing of activities on Crown land is permissible under Part 4 of the *CL Act* and must be consistent with the purpose of the reserve (i.e. public recreation and coastal environment protection). Leasing and licensing must not restrict public access.

Leasing is usually proposed when a substantial investment is proposed for an area of Crown land (e.g. a golf course). Licenses are used when intermittent or short-term occupation or control of all or part of an area of Crown land is proposed (e.g. license to operate commercial kayak activities). Under Section 106 of the *CL Act*, proceeds from lease or licensing of reserves must be used either as directed by the Minister administering the *CL Act* or for the general purposes of the reserve trust.

Under Part 5, Division 5 of the *CL Act*, the Minister may only consent to the sale, lease, easement, licence or mortgage in respect of land where the Reserve Trust has applied to the Minister and the Minister has provided consent in writing to the proposal. Temporary licenses however can be granted under Part 5 Division 5 of the *CL Act* by the reserve trust for any prescribed purpose.

Temporary licenses however cannot be granted for any purpose for which an authority, permit, lease or license may be granted under the *FM Act*. As this Plan applies to submerged land, it is likely that where any licenses or permits are required, they will require concurrence under the *FM Act* (refer **Appendix 1, Table A1** for more detail on *FM Act*).

A summary of the current process for obtaining a lease or licence, when DPI approval is required, is included in **Appendix 5**.

There are two types of licenses for areas that are within or adjacent to the study area. One is domestic waterfront licenses provided to adjacent landholders for use of land that abuts their properties. Seven domestic waterfront licenses have been granted at time of writing, all are for reclamation of land for use by the land owner.

There are two licenses on adjoining land for commercial operations on Narrabeen Lagoon (paddle board and sailing schools).

Existing leases and licences will not be affected by this Plan. However future leases or licences that fall within the boundary of the Plan will be dealt with in accordance with the Plan.

When negotiating leases or licences for commercial activities, the Reserve Trust Manager will invite competitive tenders or proposals in order to attract the best operator and financial return for the trust.

4.4.3 Reporting and Review

In line with Section 122 of the *CL Act*, the Reserve Trust Manager must prepare and submit an annual report to the Minister administering the *CL Act* within three months of the close of the Trust's financial year. Information required in the annual report will adhere to that specified in clause 32 of the *Crown Lands Regulation 2006* and detailed in the trust handbook. This includes, but is not limited to, the following information:

- Usage and the number of visitors to the reserve.
- Details of any funding received by the reserve.
- Details of any leases/licences.
- Details of any improvements on the reserve.
- Details of any:
 - Heritage programs.
 - Environmental programs.
 - Fire prevention programs.
 - Risk management programs.
 - Complaints registers.
 - Maintenance programs.
 - Other programs or plans.

The Plan of Management will be reviewed between five (5) to 10 years after approval by the Minister administering the *CL Act*. At regular intervals, as per the timeframe of the Plan, the management strategies will be reviewed and updated if required.

4.5 Relationship Of This Document To Surrounding Plans Of Management

4.5.1 Current Plans of Management

Bushland reserves and parkland surround most of the lagoon foreshores acting as a buffer to many inputs to the lagoon. This land is managed through Plans of Management (PoMs) under the *CL Act*¹⁰ or *LG Act*¹¹.

There are seven reserves and three general plans with management strategies that relate to Narrabeen Lagoon:

- Generic Plan of Management for Warringah Bushland Reserves (PoM adopted by Warringah Council August 2009).
- Berry Reserve (PoM adopted by Warringah Council June 2000).
- Jamieson Park Reserve (PoM adopted by Warringah Council April 2000).
- Bilarong Reserve (PoM adopted by Pittwater Council June 2008).
- Deep Creek Reserve (PoM adopted by Pittwater Council 1997).
- Sydney Lakeside Holiday Park (Draft PoM November 2009).
- Pittwater Ocean Beaches- North Narrabeen Rock Pool (PoM adopted by Pittwater Council February 2005).
- North Narrabeen Headland Reserve (PoM adopted by Pittwater Council October 2002).
- South Creek Reserve (Dee Why Valley and South Creek Open Space Corridor PoM adopted by Warringah Council June 2008).
- Coastal Lands Plan of Management (PoM adopted September 2002).

The land covered by these Plans is shown in **Figure 11**. The Generic Plan of Management for Warringah Bushland Reserves (adopted by Warringah Council, August 2009) also applies to areas of surrounding reserves not covered by specific plans.

Management recommendations from the aforementioned Plans are focused on catchment management, improving water quality and environmental protection. Those that potentially impact on the lagoon have been considered in developing the management actions of this Plan.

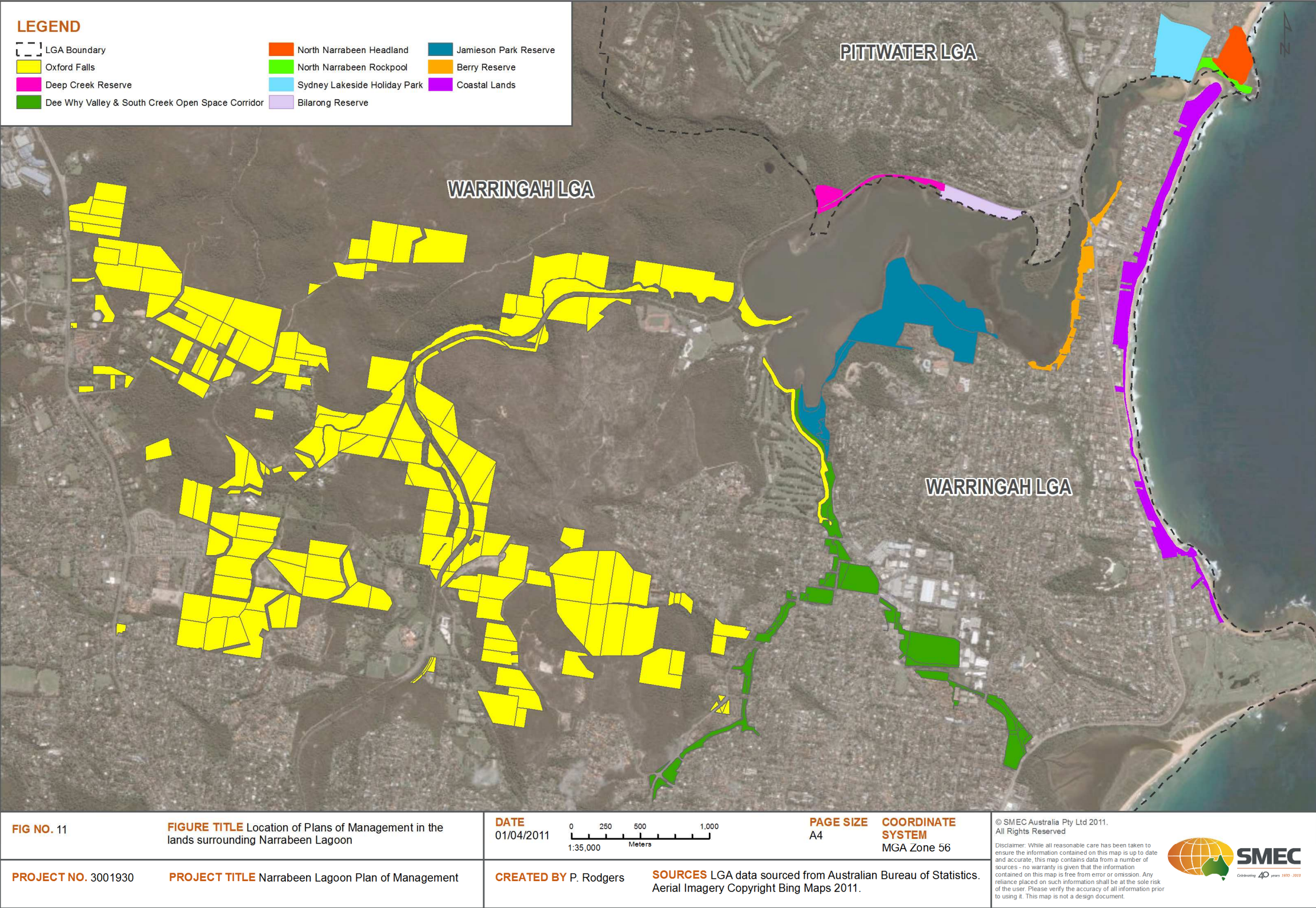
Appendix 4 (Table A6) provides a summary of management actions from the surrounding Plans and identifies how they relate to the Plan of Management for Narrabeen Lagoon. It will be important for the Reserve Trust Manager to work with surrounding landholders to ensure actions are being implemented that protect the values of Narrabeen Lagoon.

4.5.2 Future Management Considerations – State Park

In the broader context, the surrounding areas of bushland, reserves and public open space may lend themselves, sometime in the future, to the establishment of a State Park. A State Park could facilitate an integrated approach to planning and management of these valuable Crown and community lands. Presently, preparation and implementation of individual PoMs will identify common environmental issues and enable a comprehensive and integrated suite of management strategies to be developed throughout the catchment area of the lagoon.

¹⁰ A PoM is prepared for the Crown land in accordance with the CL Act by the DPI or by the reserve/dedication trust manager. DPI or the trust manager is responsible for implementation of the Plan.

¹¹ A PoM is prepared for the community land in line with the LG Act by the appropriate local council; the local council is responsible for implementation of the Plan.



Location: I:\projects\3001930 - Narrabeen Lagoon Plan of Management\009\DATA\GIS\Plan of Management

Figure 11: Location of Plans of Management in the lands surrounding Narrabeen Lagoon

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6 GLOSSARY

Action	The method for implementing a management strategy
AHIMS	Aboriginal Heritage Information Management System
ANZECC	Australia New Zealand Environment and Conservation Council
CL Act	<i>Crown Lands Act 1989</i>
DECCW	(former) Department of Environment, Climate Change and Water
DPI	Department of Primary Industries
I&I	Industry and Investment NSW
EEC	Endangered Ecological Community
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPI	Environmental Planning Instrument
FM Act	<i>Fisheries Management Act 1994</i>
ICOLL	Intermittently Closed and Open Lakes and Lagoons
LEP	Local Environmental Plan
LGA	Local Government Area
LTWL	Lagoon top water level (0.7 m AHD)
MNES	Matter of National Environmental Significance
NHMRC	National Health and Medical Research Council
NPW Act	<i>National Parks and Wildlife Act 1974</i>
Objective	The purpose or goal of the management of Narrabeen Lagoon
OEH	Office of Environment and Heritage
Performance Measure	How the action will be measured against a performance target
Performance Target	The ideal outcome of the action
PoEO Act	<i>Protection of the Environment Operations Act 1997</i>
Plan	Plan of Management
Reserve Trust Manager	Responsible for the care, control and management of the Narrabeen Lagoon Reserve (separate legal entity to Warringah Council established under the <i>Crown Lands Act 1989</i>)
SEPP	State Environmental Planning Policy
Strategy	A plan to preserve one of the values identified for Narrabeen Lagoon
SQUIDS	Stormwater Quality Improvement Devices
Study area	The land that this Plan applies to (See Section 1.2)
TSC Act	<i>Threatened Species Conservation Act 1995</i>
Value	Identified as an important aspect of Narrabeen Lagoon, by the community, Council, DPI or SMEC
WM Act	<i>Water Management Act 2000</i>

7 ACKNOWLEDGEMENTS

SMEC Australia Pty Ltd was commissioned by Warringah Council to prepare this Plan of Management for Narrabeen Lagoon. SMEC engaged Straight Talk to undertake the community consultation component and we particularly thank Abbie Jeffs and Gabbie Higgins for their invaluable assistance in the development of the Plan.

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SMEC would particularly like to thank the local community members who attended community workshops, provided input on web forums or comments on the Draft Plan of Management.

APPENDIX 1: LEGISLATIVE FRAMEWORK

Table A1 Key State legislation applying to activities under this Plan

Legislation	Description of the Act	How this Act has formed the Plan	Approvals, Permits and Licences that may be required for 'Development' and Activities under this Plan
<i>Crown Lands Act 1989</i>	The <i>Crown Lands Act 1989</i> (the <i>CL Act</i>) facilitates the planning, management and use of Crown land. Narrabeen Lagoon is 'owned' by the State of NSW and is administered as Crown land under the <i>CL Act</i>. Part 5 Division 6 of the <i>CL Act</i> outline the provisions for the preparation of a Plan. The <i>CL Act</i> provides a mechanism for the "care, control and management" of Crown land rather than a framework for development or undertaking an activity. Provisions for the development of land and undertaking activities can be found under the <i>EP&A Act</i>.	The <i>CL Act</i> is considered the primary legislative provision for the preparation of the Plan for Narrabeen Lagoon. Crown land is managed under the principles of Crown land management as defined in S11 of the <i>CL Act</i>, namely: - that environmental protection principles be observed in relation to the management and administration of Crown land. - that the natural resources of Crown land (including water, soil, flora, fauna and scenic quality) be conserved wherever possible. - that public use and enjoyment of appropriate Crown land be encouraged. - that, where appropriate, multiple use of Crown land be encouraged. - that, where appropriate, Crown land should be used and managed in such a way that both the land and its resources are sustained in perpetuity. - that Crown land be occupied, used, sold, leased, licensed or otherwise dealt with in the best interests of the State consistent with the above principles. The study area includes "submerged Crown land" (land that is submerged by water), therefore the draft Plan will need to be referred to (and have the concurrence of) the Minister administering the <i>FM Act</i> before it is adopted. The draft Plan will be displayed for a minimum period of 28 days with submissions considered by the Minister administering the <i>CL Act</i>, and may be adopted with or without alteration.	- DPI – Fisheries (Aquatic Habitat Protection) or Reserve Trust Manager consent is required to lodge a development application for any activity on Crown land. - Section 34A, lease or licence for infrastructure/ activity on Crown land. - Temporary licences (Section 108 (1) of the Act and clause 31 of the <i>Crown Lands Regulation 2006</i>). Temporary licences allow the trust to permit short-term (up to one year) and generally low impact activities on the reserve, provided they fall within one of the permitted purposes under clause 31.

Legislation	Description of the Act	How this Act has formed the Plan	Approvals, Permits and Licences that may be required for 'Development' and Activities under this Plan
<i>Environmental Planning & Assessment Act 1979</i>	The <i>Environmental Planning & Assessment Act 1979 (EP&A Act)</i> is the prevailing planning legislation that applies to all development and environmental assessment within NSW and permits the creation of Environmental Planning Instruments (EPIs) such as State Environmental Planning Policies (SEPPs) and Local Environmental Plans (LEPs).	Any future development or activity to be undertaken on land to which the Plan applies will need to have regard to the <i>EP&A Act</i> and the various Environmental Planning Instruments administered under it (refer Table A3).	Part 4 Designated Development: ▪ EIS to accompany a Development Application to the Consent Authority (Council). Part 4 Development (not designated development): ▪ SEE to accompany a Development Application to the Consent Authority (Council). Part 5 Activities (not under <i>SEPP Infrastructure 2007</i>): ▪ REF, or EIS if there is likely to be a significant impact on the environment for assessment by Determining Authority (Council or Government Agency - Minister for Planning if Government Agency activity requiring EIS). Part 5 Activities under SEPP (Infrastructure) 2007: ▪ REF for assessment by Determining Authority (Council or Government Agency).

Legislation	Description of the Act	How this Act has formed the Plan	Approvals, Permits and Licences that may be required for 'Development' and Activities under this Plan
<i>Local Government Act 1993</i>	The purpose of the <i>Local Government Act 1993 (LG Act)</i> is to provide the legal framework for an effective, efficient, environmentally responsible and open system of local government in NSW.	Section 48 of the Act relates to responsibility for public reserves as follows. Except as provided by Section 98A of the <i>Crown Lands Act 1989</i>, a council has the control of: - Public reserves that are not under the control of or vested in any other body or persons and are not held by a person under lease from the Crown. - Public reserves that the Governor, by proclamation, places under the control of the council. Section 36 of the Act relates to the preparation of Plans of Management for Community land. Although the lagoon is not Community land, Council's Policy for Plans of Management on Public Open Space (Warringah Council 2003) covers both Community and Crown land and hence has been taken into consideration in the preparation of this Plan.	For development or activities adjacent to the area covered by this Plan: Section 46, lease or licence over Community land for public utilities, activities prescribed by the <i>LG Act</i> Regulations, as authorised by a Plan of Management and as are consistent with the core objectives for the land.
<i>Coastal Protection Act 1979</i>	The aims of the <i>Coastal Protection Act 1979</i> include to: protect, enhance, maintain and restore the environment of the coastal region; promote public pedestrian access to the coastal region; allow for the appropriate use of natural and man-made resources, having regard to ESD principles; and encourage and promote plans and strategies for adaptation in response to coastal climate change impacts, including projected sea level rise.	OEH has directed Warringah Council to prepare a Coastal Zone Management Plan (CZMP) for Collaroy-Narrabeen Beach. The 2010 <i>Guidelines for Preparing Coastal Zone Management Plans</i> under section 55D of the Coastal Protection Act state that plans can cover both the open coast and associated estuaries. If the CZMP is to include the lagoon, the Narrabeen Lagoon Plan of Management will assist in the preparation of the CZMP.	Although Section 38 of the Act refers to the Minister's concurrence for use, occupation or development in the coastal zone, this generally only applies in areas where a CZMP or equivalent plan does not exist.

Legislation	Description of the Act	How this Act has formed the Plan	Approvals, Permits and Licences that may be required for 'Development' and Activities under this Plan
<i>Aboriginal Land Rights Act 1983</i>	The <i>Aboriginal Land Rights Act 1983</i> provides land rights for Aboriginal persons in NSW by specifying the requirements for representative Aboriginal Land Councils and providing a legal mechanism for the acquisition of land, and the management of land and other assets and investments, by or for those councils. Under the Act, the NSW Aboriginal Land Council and Local Aboriginal Land Councils may make claim(s) to claimable Crown land(s).	An Aboriginal Land Claim lodged over the bed of Narrabeen Lagoon was refused on 25 May 2010.	If a Land Claim was successful, the land would become freehold owned by the Aboriginal Land Council or any subsequent owner if the land was sold. Accordingly, this Plan would become redundant as the lagoon bed would no longer be Crown land. Approvals for any development or activities would be as per any other private developer.
<i>Fisheries Management Act 1994</i>	The <i>Fisheries Management Act 1994 (FM Act)</i> governs the conservation, development and management of fishery resources for the benefit of NSW.	In terms of consultation for the Plan, a copy will need to be referred to the Minister administering the <i>FM Act</i> prior to adoption, as the Plan will apply to submerged land (Section 116 of the <i>CL Act</i>). Officers of DPI-Fisheries have been consulted throughout the preparation of this Plan.	▪ Section 199, Notification of proposed dredging or reclamation work by a State Government agency. ▪ Section 201, Permit for dredging or reclamation (not required for State Government agency works). ▪ Section 205, Permit to remove marine vegetation. ▪ Section 219, Permit to create an obstruction across a watercourse/ waterway. ▪ When undertaking environmental assessment for any activity, species, populations and ecological communities listed under Schedules 4, 4A and 5 to the <i>FM Act</i> must be considered.

Legislation	Description of the Act	How this Act has formed the Plan	Approvals, Permits and Licences that may be required for 'Development' and Activities under this Plan
<i>Threatened Species Conservation Act 1995</i>	The <i>Threatened Species Conservation Act 1995 (TSC Act)</i> lists threatened species, populations and ecological communities in NSW. If a threatened species, population or ecological community or its habitat is likely to occur in any area which may be affected by a development proposal or activity, then an assessment of significance ('seven-part test') in accordance with Section 5A of the <i>EP&A Act</i> must be conducted to determine whether there would be a significant effect. Should it be determined that a development or activity is likely to have a significant effect on a species, then a "Species Impact Statement" would need to be prepared.	As part of the Due Diligence Report, a number of threatened species and ecological communities were identified within and immediately surrounding the study area. Chapter 3 of this Plan provides a summary.	- When undertaking environmental assessment for any activity, species, populations and ecological communities listed on Schedules 1, 1A and 2 of the <i>TSC Act</i> must be considered. - Section 91, Licence to harm a threatened species or damage the habitat of a threatened species or ecological community.
<i>Heritage Act 1977</i>	Natural, cultural and built heritage is protected under the <i>Heritage Act 1977</i> . This Act allows for heritage items or places to be listed on the State Heritage Register, or for interim heritage orders to be made to protect heritage items or places. Section 170 of the Act requires government instrumentalities to establish a Heritage and Conservation Register.	Three listed heritage items occur within (or immediately adjacent) to the study area; the Narrabeen Lake Bridge, the Cement Works Ruin at Deep Creek and remnants of a stone jetty associated with the ruins of Wheeler Homestead. Any future development within the study area will need to be sympathetic to the heritage significance of the listed heritage items.	- Approval from the Heritage Council or local council before work can be done which might damage a heritage item or place. - Section 139, Permit to excavate/ disturb a relic.

Legislation	Description of the Act	How this Act has formed the Plan	Approvals, Permits and Licences that may be required for 'Development' and Activities under this Plan
<i>National Parks and Wildlife Act 1974</i>	The <i>National Parks and Wildlife Act 1974</i> (NPW Act) is state legislation that provides a planning mechanism for the conservation of biodiversity, habitat and other areas of ecological and biophysical significance. It also provides legislative protection for Aboriginal heritage. One key environmental planning issue that the NPW Act covers is the statutory protection for all Aboriginal objects and places in NSW. Aboriginal rocks include physical evidence of past Aboriginal occupation, such as rock art, rock engravings, shell middens and camp sites. Areas are gazetted as Aboriginal places if the Minister is satisfied that there is enough evidence to show the area is, or was, of special significance to Aboriginal culture. It also aims to provide for protection and management of National Parks in NSW through environmental management and protection of Indigenous heritage.	An AHIMS (Aboriginal Heritage Information Management System) search was completed for the study area (with a buffer of approximately 200 metres around the lagoon in a rectangle) to determine whether any Aboriginal sites had been recorded in close proximity. It was found that no recorded sites occur within the study area. If any sites were to be discovered in the future the trust should inform National Parks NSW and AHIMS	Section 90, Permit to damage or destroy Aboriginal object or place

Legislation	Description of the Act	How this Act has formed the Plan	Approvals, Permits and Licences that may be required for 'Development' and Activities under this Plan
<i>Water Management Act 2000</i>	The <i>Water Management Act 2000 (WM Act)</i> deals with the management of surface and groundwater in NSW. It defines a number of controlled activities including the following: ▪ Erection of a building or the carrying out of work (within the meaning of the <i>EP&A Act</i>). ▪ Removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise. ▪ Deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise. ▪ Carrying out of any other activity that affects the quantity or flow of water in a water source.	The principles of the Water Management Act have been taken into account in the preparation of this plan, in particular: ▪ water sources and dependent ecosystems should be protected and restored. ▪ the water quality of all water sources should be protected and, wherever possible, enhanced. ▪ the principles of adaptive management should be applied, which should be responsive to monitoring and improvements in understanding of ecological water requirements.	▪ Section 91 Activity Approval for controlled activity in, on or under waterfront land ▪ Section 90 Approval for flood work
<i>Protection of the Environment Operations Act 1997</i>	The <i>Protection of the Environment Operations Act 1997 (PoEO Act)</i> is administered by OEH. The <i>PoEO Act</i> establishes the NSW environmental regulatory framework and determines whether an environmental protection license is required for a proposed activity.	Under Clause 6(2) a local authority is the appropriate regulatory authority for non-scheduled activities in its area. The risk of water pollution should be taken into account in considering activities permitted under this Plan.	Section 43, Environment Protection Licence for scheduled development or activities.

Table A2 Key Commonwealth legislation applying to activities under this Plan

Legislation	Description of the Act	How this Act has formed the Plan	Approvals, Permits and Licences that may be required for 'Development' and Activities under this Plan
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	The Commonwealth <i>EPBC Act</i> is administered by the Department of Sustainability, Environment, Water, Population and Communities. It is concerned with impacts on Matters of National Environmental Significance (MNES) including: ▪ World heritage properties. ▪ Ramsar wetlands. ▪ National threatened species and ecological communities. ▪ Migratory species. ▪ Commonwealth marine areas. ▪ Nuclear actions.	Some MNES within or immediately surrounding the study area (within 500 metres) including several threatened flora and fauna species have been identified in this Plan. Further information on the threatened species recorded within and immediately surrounding the study area is outlined in Section 3.	Under a bilateral agreement the NSW assessment process under the <i>EP&A Act</i> has been accredited for assessment purposes under the <i>EPBC Act</i>. However, the Commonwealth would still need to issue a separate approval for a Controlled Action (i.e. works that were likely to have a significant impact on a MNES).
<i>Native Title Act 1993</i>	The <i>Native Title Act 1993</i> recognises and protects Native Title (traditional ownership of land and waters by Aboriginal people). It provides a process by which Native Title rights can be established and compensation determined, and by which determinations can be made or acts done as to whether future grants can be made over Native Title land and waters. 'Native Title' is defined as the rights and interests that are possessed under traditional laws and customs of Aboriginal peoples or Torres Strait Islanders in relation to land or waters and that are recognised by the common law of Australia. Native Title is subject to the general laws of Australia, although Native Title rights to hunt, fish and carry on other activities may be exercised without the need for a licence or permit where others can carry out the activity only with a licence or permit.	The <i>Native Title Act 1993</i> validates past acts by the State government and confirms extinguishment of native title by past public works. However, Native Title may continue to exist in areas such as Crown land, national parks, forests and public reserves, beaches and other areas that are not privately owned. For Crown reserves created on or before 23 December 1996 (most of Narrabeen Lagoon), all actions that may be undertaken in the care, control and management of the reserve may be validly undertaken even though they might affect native title, as long as the action is undertaken in good faith, in accordance with the public purpose of the Crown reservation and in accordance with the notice requirements of the Native Title Act 93.	Section 24JB, Notice of proposed public work (this includes major earthworks, such as dredging) that is likely to affect native title to: ▪ any registered native title body corporate (i.e. corporations established to hold native title where there has been a determination of native title) for the land. ▪ any registered native title applicant for the land. ▪ the Aboriginal and Torres Strait Islander Representative Body for NSW (currently NSW Native Title Services Ltd).

Table A3 Key environmental planning instruments applying to activities under this Plan

EPI	Description of the Policy/Plan	How this Policy/Plan has formed the Plan
<i>State Environmental Planning Policy (Infrastructure) 2007</i>	State Environmental Planning Policy (Infrastructure) 2007 is intended to facilitate the efficient delivery of infrastructure projects. In the case of public authorities, such as Council, SEPP Infrastructure overrides local environmental planning controls for projects relating to, amongst others: ▪ Parks and other public reserves (Part 3 Division 12). ▪ Flood mitigation works (Part 3 Division 7). ▪ Wharf or boating facilities (Part 3 Division 13). ▪ Stormwater management systems (Part 3 Division 20). ▪ Waterway and foreshore management (Part 3 Division 25). This includes dredging to rehabilitate aquatic habitat or to maintain or restore environmental flows or tidal flows for ecological purposes; and routine maintenance works including dredging, or bed profile levelling, of existing navigation channels if it is for safety reasons or in connection with existing wharf or boating facilities.	Under this SEPP, many types of development may be carried out by Council or other public authorities without consent. Development 'for any purpose' may be carried out by the reserve trust on land to which a Plan applies, if the development is consistent with the Plan. Works however may still need further approvals and permits such as S.201 or S.205 permits from DPI.
<i>State Environmental Planning Policy No. 71 – Coastal Protection</i>	The aims of SEPP 71 are to protect and manage the natural, cultural, recreational and economic attributes of the NSW coast, including the beaches, coastal vegetation, Aboriginal heritage etc.	Narrabeen Lagoon is listed as a Coastal Lake under this policy. Clause 8 of this SEPP lists matters for consideration (in addition to those contained in the <i>EP&A Act</i>) in determining development applications.
<i>Warringah Local Environmental Plan 2000</i>	Warringah Local Environmental Plan 2000 (LEP) identifies 'Localities' to determine what can be carried out in the LGA based on the character of the natural and built environment within the area. Narrabeen Lagoon is located within locality B10. Locality B10 of the LEP identifies the desired future character of Narrabeen Lake as being 'preserved in its natural state surrounded by areas of open space which complement the lake'.	The only development permitted in the Narrabeen Lake locality is maintenance dredging and minor low intensity structures, such as viewing and fishing platforms constructed of sensitive materials and colours, may occur within the locality. In addition, the foreshore areas comprising community land within the locality may be developed only in a manner that is consistent with the relevant community land plan of management. Under Clause 17 of the LEP, any development of public open space must also be consistent with a Plan of Management for that land prepared in accordance with the <i>LG Act</i> in the case of public open space that is owned by Council, or a Plan prepared in accordance with the <i>CL Act</i> in the case of public

EPI	Description of the Policy/Plan	How this Policy/Plan has formed the Plan
		open space that is Crown land. Appropriate environmental assessment and cost benefit analysis however still needs to be undertaken and appropriate permits/approvals sought prior to any works/activities being carried out.
Draft Warringah Local Environmental Plan 2009	Council prepared a Draft LEP in accordance with the Standard Instrument (Local Environmental Plan) Order 2006. Council's draft Warringah Local Environmental Plan (LEP) 2009 and associated documents were exhibited from October 12 to December 30, 2009. This version, certified by the Department of Planning on 9 September 2009, has draft legal status under the NSW planning legislation. Following the exhibition and consideration of submissions received, Council adopted an amended version of LEP 2009 on 8 June 2010.	Under the certified draft LEP, two zonings are applicable to the area covered by this Plan: ▪ W1 Natural Waterways (the W1 zone) which applies to land below the top water level of Narrabeen Lagoon. ▪ RE1 Public Recreation (the RE1 zone) which applies to the lagoon island located in the central basin. All other land uses within the RE1 zone are prohibited unless accounted for under any local provisions of the Draft LEP, SEPPs or deemed-SEPPs. Under Section 79C of the <i>EP&A Act</i>, any future development within the applicable part of Narrabeen Lagoon must take into account the zoning provisions of the Draft LEP amongst other matters.

Other potentially relevant legislation

Other policies, plans and guidelines which may be relevant to proposed development or activities under this Plan include:

- Crown Lands Policy for Marinas and Waterfront Commercial Tenures (2005).
- Crown Lands NSW Business Directive 2004 for Commercial Leasing and Licensing of Crown Land.
- Investment Policy for Trust Boards Managing Crown Reserves and Commons (2005).
- Crown Lands Policy for Tourist & Associated Facilities on Crown Land (2006).
- NSW Floodprone Land Policy and Floodplain Development Manual (NSW Government 2001).
- Acid Sulfate Soil Manual if proposed works require the removal of bed sediments (NSW Acid Sulfate Soil Management Advisory Committee 1998).
- Guidelines Aquatic Habitat Management & Fish Conservation 1999 Update (DPI - Fisheries (Aquatic Habitat Protection) Fisheries).
- Warringah Development Control Plan (2008).
- Interim Policy on the Management of the Commercial Use of Beaches, Reserves & Buildings/Facilities in Warringah (Warringah Council 2002).
- Filming on Council Managed Land Policy (Warringah Council 2010a).
- Policy for the Use of Council Open Space for Commercial Fitness Groups and Personal Trainers (Warringah Council 2010a).
- Narrabeen Lagoon Entrance Management Operational Management Standard EM-OMS-420 (Warringah Council 2007)
- Physical Access Policy (Warringah Council 1998).
- Protection of Waterways and Riparian Land Policy (Warringah Council 2010a).
- Stormwater Drainage Policy (Warringah Council 1992).
- Water Sensitive Urban Design (Warringah Council 2004).
- *Marine Safety Act 1998*: in relation to the regulation of recreational boating on the lagoon.
- *Water Act 1912*, Division 3: licence requirements for temporary dewatering or water extraction.
- Warringah Council Recreation Strategy (Warringah Council 2009)
- Strategic Community Plan (WC 2009) and Draft Strategic Community Plan (Warringah Council 2011)
- *Disability Discrimination Act 1992*: in relation to provision of disabled access for any proposed developments.

APPENDIX 2: TRANSLATION OF OPTIONS FROM THE VALUES, ISSUES AND OPTIONS PAPER TO ACTIONS OF THIS PLAN

Table A4 Translation of options from the Values, Issues and Options Paper to actions of this Plan

Value	Option from Narrabeen Lagoon Values, Issues and Options Paper	Management Action in Narrabeen Lagoon Plan, Table 2
Natural Environment		
Bush land areas especially high conservation value	1. Public education and engagement e.g. sign-posting.	EP8, EP9
	2. Walking tracks may be delineated and signposted to restrict access and protect sensitive areas.	This option was not incorporated into the Plan management actions as implementation is outside the area the Plan covers.
	3. Undertake appropriate bush regeneration including managing and prioritising adjacent bush reserves across the LGA in accordance with Councils policies, plans and bushland management programs.	EP9, EP11
	4. Manage pest species in accordance with Councils management programs and with appropriate legislation including <i>Noxious Weeds Act 2003</i> .	EP5, EP 6, EP11
	5. Education and engagement on importance and sensitivity of lagoon and surrounding reserves.	EP9
	6. Investigate waste management options, including ways to reduce volume of rubbish getting into waterways and enforcement of no littering (e.g. removal of horse and dog faeces as well as paper and plastic).	EP1
	7. Planning for increased volume of visitors, balancing human and natural environment needs.	PR1. Work with Warringah Council (as local consent authority) to facilitate holistic approach to management of public recreation on the lagoon to allow use and enjoyment of the lagoon while minimising environmental impacts.
	8. Where appropriate, cordon or fence off sensitive areas especially during breeding season. Fences shall be in accordance with any standards or guidelines adopted by Council.	EP5, EP9, EP11
	9. "No mow zones" could be implemented to encourage native understorey, particularly in EEC areas.	This option was not incorporated into the Plan management actions as implementation is outside

Value	Option from Narrabeen Lagoon Values, Issues and Options Paper	Management Action in Narrabeen Lagoon Plan, Table 2
		the area the Plan covers.
	10. Holistic approach to bush fire management, including prioritising of high risk areas across LGAs. Manage in accordance with Warringah Pittwater Bush Fire Management Committee's bushfire mitigation programs and Warringah LGA Hazard Reduction Guidelines (EcoLogical 2006). Hazard reduction programs are to include adequate environmental assessments in accordance with the relevant legislation and be implemented in a manner which protects biological diversity.	This option was not incorporated into the Plan management actions as implementation is outside the area the Plan covers.
	11. Any activity including development on or near the lagoon must take into account impacts on threatened species and their habitats e.g. ensure planning controls for development surrounding the lagoon are enforced.	EP4
	12. Record data on threatened species by Council's GIS.	EP4, EP5, EP10
Wildlife corridors	13. Planning instruments and development assessments to include/consider known corridors and currently contiguous vegetation.	EP4, EP5
Aquatic habitat	14. Natural hydrological processes are to be maintained where possible, this could include clearing particular areas of sediment build up, after sufficient analysis of environmental benefits and impacts of removal.	EP3, EP4, EP5, EP6, EP7
	15. Measures which minimise and control sediments and nutrients entering the lagoon and tributaries may be implemented following sufficient needs and effectiveness analysis and environmental assessment.	EP2, EP3, EP4
	16. Investigate waste management options including decreasing volume and increase quality of stormwater outputs (e.g. re-use of water by households, installation of SQUIDS, including gross pollutant traps).	EP1
	17. Where necessary, investigate causes and indicators of eutrophication.	EP2, EP3
	18. Endeavour to maintain water quality entering the lagoon at a level which is acceptable for sustainable natural area management.	EP1, EP2, EP3

Value	Option from Narrabeen Lagoon Values, Issues and Options Paper	Management Action in Narrabeen Lagoon Plan, Table 2
	19. Effectively communicate environmental information to community regarding lagoon management (e.g. what affects water quality in the lagoon and sediment deposition).	EP8, EP9
	20. Manage powered watercraft access to reduce impact on lagoon banks (e.g. speed limits, bans, increase in patrol/compliance).	PR2
	21. Regular review of entrance management regimes in conjunction with Pittwater Council to make sure that most efficient and effective management of this area is maintained.	PR9, PR10
	22. Undertake necessary studies, where possible, to identify and gather further information on species of significance.	EP5, EP11
	23. Undertake impact assessment on new developments/activities and ensure appropriate mitigation measures are implemented.	EP4
	24. Measures may be implemented to maintain and improve potential habitat following sufficient needs and effectiveness analysis.	EP5, EP11
	25. Ensure measures are implemented to protect flora and fauna of significance.	EP4, EP5, EP6, EP7, EP9, EP11, EP12
	26. Consider inclusion of Coastal Saltmarsh in Councils vegetation management programs.	EP5 , EP6, EP11
	27. Implement measures to encourage the long-term sustainability of seagrass beds. Any activities or development likely to affect Seagrass or Saltmarsh will require appropriate environmental assessment.	EP10, EP11
	28. Measures which minimise nutrients entering the lagoon and its tributaries may be implemented with sufficient needs and effectiveness analysis and environmental assessment.	EP2, EP3, EP4
	29. Discourage the development of activities that impact seagrass and saltmarsh communities.	EP4, EP5, EP6

Value	Option from Narrabeen Lagoon Values, Issues and Options Paper	Management Action in Narrabeen Lagoon Plan, Table 2
Water Based Recreation		
Swimming	30. Designate swimming areas to avoid damage to banks and aquatic vegetation and provide equitable access.	PR4
	(6.) Investigate waste management options, including ways to reduce volume of rubbish getting into waterways and enforcement of no littering (e.g. removal of horse and dog faeces as well as paper and plastic).	EP1
	(1.) Public education e.g. sign posting.	EP8, EP9
Sailing, kayaking and similar activities	(1.) Public education e.g. sign posting.	EP8, EP9
	31. Investigate bathymetry to manage recreation use (i.e. appropriate depth for each activity, then designate areas for each activity in accordance with depth).	PR5
	32. Where positive cost benefit and appropriate environmental assessment completed, consider locations for providing increased water depth.	PR5
	33. Manage wash down and put in areas to reduce impact on natural environment.	PR6
	34. Holistic approach to management of recreation on the lagoon to allow use and enjoyment of the lagoon while minimising environmental impacts.	PR1
Fishing	35. Public education on size limits and types of fish in the lagoon.	PR8
	36. Provide any available information to the community on the safety of consuming fish.	PR8
Amenity		
Intact bush land	37. Public education e.g. sign posting and engagement on importance and sensitivity of the lake and surrounding reserves to reduce users impact.	EP8, EP9

Value	Option from Narrabeen Lagoon Values, Issues and Options Paper	Management Action in Narrabeen Lagoon Plan, Table 2
	38. Provide appropriate litter facilities.	This option was not incorporated into the Plan management actions as implementation is outside the area the Plan covers.
	39. Maintain and improve litter reduction strategies such as gross pollutant traps.	EP1
Accessibility	40. Monitor use of lagoon and determine what enhancements could be made.	PR1, PR2, PR3, PR5, EP7
	41. Manage walking tracks and other facilities so that impact on ecology and other values of lagoon are minimized.	This option was not incorporated into the Plan management actions as implementation is outside the area the Plan covers.
	42. Manage foreshore to promote access and minimise environmental disturbance.	PR1, PR6, EP9
	43. Encourage and assist user groups (e.g. bush care) – co-ordinate approach with Council.	EP8, EP9
	44. Existing facilities to be maintained in accordance with Council maintenance program.	PR6
	45. Recommend that appropriate facilities for all users in surrounding areas are maintained and improved (subject to applicable management plan).	PR6
Commercial sustainability	46. Permit appropriate types and numbers of commercial uses that reduce or have no impact on other values such as vista and peace of the area and biodiversity.	PR1, EP4, Admin 4, Admin 5
	47. Encourage low ecological impact use of the lagoon and surrounding areas. Investigate ways to reduce impacts of these activities further (e.g. recycling, re-use of water, rubbish removal).	EP4, PR1, Admin 4
History, heritage and sense of place	48. Identify heritage items, particularly those at risk, and provide measures in the Plan to protect these.	EP10, EP12

Value	Option from Narrabeen Lagoon Values, Issues and Options Paper	Management Action in Narrabeen Lagoon Plan, Table 2
	49. Manage Aboriginal heritage in accordance with <i>Aboriginal Heritage and Heritage Act 1977</i> and <i>National Parks and Wildlife Act 1974</i> .	EP10
Presence and use of the parkland and reserve areas surrounding the lagoon (enabling appreciation of the lagoon from a natural bush land setting)	50. Investigate appropriate waste management options.	EP1
	51. Educate and engage the community on the importance and sensitivity of the lake and surrounding reserves and human impacts.	EP8, EP9
	52. Ensure options of this Plan are consistent, where appropriate, with Plans for adjoining lands. If any conflicting options arise the most appropriate option should be discussed in the consultation process.	This option was not included as an action in the Plan. It is addressed in Section 4.3 of the Plan.
Use of the lagoon and foreshore for a variety of uses	53. Establish clear lease/licensing rules and objectives to ensure use of the Lagoon is sustainable.	PR1, Admin 4, Admin 5
Manage potential impacts of flooding		
On commercial and residential properties situated in close proximity to the Lagoon	54. Undertake flood analysis and manage the floodplain in accordance with the Floodplain Development Manual as required under the <i>LG Act</i> . Manage the floodplain in accordance with the management options identified through the flood analysis and associated investigation, which includes options to reduce flooding e.g. entrance clearance.	PR9, PR10
	55. Ensure that Narrabeen Lagoon Floodplain Risk Management plans include an assessment of the impacts of climate change and plans are implemented to manage changes to flood behaviour.	PR9
	56. Manage flood risk through licences.	PR9, Admin 4, Admin 5
	57. Plan for increased frequency of flooding, as a result of climate change.	PR9, PR10, PR11
Use of the lagoon and foreshore for a variety of uses	58. Manage in accordance with <i>Water Management Act 2000</i> .	Relevant legislation associated with management of the Lagoon is detailed in Section 1.6 and Appendix 1 of the Plan.

Value	Option from Narrabeen Lagoon Values, Issues and Options Paper	Management Action in Narrabeen Lagoon Plan, Table 2
	59. Consider and implement appropriate recommendations for protection of commercial and residential property from current flood management plans for the area.	PR9, PR10, PR11
	60. Determine if inundation poses a threat to any natural areas.	PR9, PR10, EP7

APPENDIX 3: RESPONSE TO SUBMISSIONS RECEIVED FROM PUBLIC EXHIBITION OF THE DRAFT PLAN OF MANAGEMENT

The following table summarises the issues raised in submissions and provides responses to these, including where amendments have been made to the Plan. A certain degree of paraphrasing has been necessary and care has been taken to preserve the intent of the issue. A variety of issues were raised however, not all relate specifically to the Plan of Management as they concern matters outside the area covered by the Plan.

The identities of individual community members who made submissions have not been provided for privacy reasons.

Table A5 Response to Submissions received from Public Exhibition of the Draft Plan of Management

Government

Agency	Issues	Response
Sydney Metropolitan CMA	Consistency with use of government department names.	A section will address this and document checked.
	Catchment wide context and further links to other Plans, especially results of Deep Creek.	Reference to this is included in the text (Section 4.5). Such a catchment wide approach is desirable but the Reserve Trust Manager will not have jurisdiction outside of the Plan area, therefore it is not possible to include management actions for these areas, however a theme through the document is to work closely with surrounding land managers to address catchment issues
	Wildlife corridors should be considered.	See Section 4.5.2 and comment above.
	Management of surrounding land and acknowledgement of impacts on lagoon.	As above.
	Consultation with local community (including Aboriginal groups) needs to be documented.	See Section 2.2. More detail on this has been added.
	More discussion of threats is needed.	Detailed analysis of threats was undertaken in the VIOP. Section 3.2 of the Plan addresses threats, also EP1.
	Threatened species listed.	These were detailed in the Due Diligence report and VIOP used to develop the Plan. There is too much detail to include in the Plan. There are a number of actions which address the management / mitigation of impacts to threatened species (see Section 4.3).

	Review existing Stormwater Management Plan and implement outstanding actions.	This has been addressed by Action EP3 (see Section 4.3). The stormwater management plan will be reviewed as required.
	Develop and implement a plan for recreational usage.	This has been addressed. See Action PR1.
	Limited environmental benefit from modifying the lagoon depth. Remove EP7.	There are studies showing diminished water quality in some of the deep dredge holes in Narrabeen Lagoon as a result of historic dredging activities. EP7 will remain since any dredging would need to be done after appropriate environmental assessment.
	How will Council/assess and evaluate the Plan's objectives and performance measures?	Annual report which is a requirement of Council as Reserve Trust Manager. Action plans for specific assessment and actions.
Australian Heritage Office	Wheeler Heights item	Reference deleted in view of distance from lagoon
	Lagoon perimeter has been subject to disturbance and thus the archaeological potential is reduced.	Noted. Managing impacts on Aboriginal heritage is already provided for through <i>EP&A Act</i> and <i>National Parks and Wildlife Act 1974</i> .
	Discrepancy between AHIMS data and Council data.	A number of items of Aboriginal heritage value are registered on Council's database, but are not on AHIMS. Council to inform OEH.
	Need to look at new AHO's Warringah Site Management Report and Aboriginal Potential Areas Report, an updated version to be available in 2012.	This has been looked at and amended in text.
Dept of Primary Industries – Fisheries	A number of specific wording changes mostly relating to change in Government Departments and correct status of species.	Addressed.
	Acknowledgement of incorporation of input from DPI on VIOP and Due Diligence Report.	Noted.
	Hairy Pipefish (<i>Urocampus carinirostris</i>) is	Amended in document. Correct references to rare and threatened species has

	listed marine species under Commonwealth EPBC Act and is a protected species under the FM Act.	been addressed.
Office of Environment & Heritage	Change of references to DECCW to OEH.	Amended. Note that where documents are referenced the name at time of publication is retained.
	Importance of management of Lantana.	Much of the areas requiring management for Lantana fall outside the area of the Plan. If found to be a problem on one of the islands within the Plan area, this would be covered under a specific action plan developed under this Plan.
	OEH would like to be consulted in management of Coastal Saltmarsh.	This has been included in the Plan.
	Monitoring of performance targets seem unclear, suggestion that for many requires before and after monitoring of EEC or other environment value.	Plan is principles-based. Specific monitoring tasks would be covered in actions developed under the Plan when required.

Community Groups

Group	Issues	Response
Friends of Narrabeen Lagoon Catchment	Need to add cultural values to the management actions and vision statement	The land has recently been zoned for Coastal environmental protection and recreation under the Crown Lands Act. These are the purposes that are being addressed in the Plan. Cultural heritage has been added as a key value and also added an action (EP10).
	Need to specifically allow for further community and Council-inspired promotion of heritage values	Plan provides for this. Refer to EP9.
	There is a list of known cultural heritage items (page 35) but only legal requirements associated with protecting these are to be used. No mention of public education or signage to promote understanding	Reserve Trust Manager would work with surrounding landholders to address this, however where signs would be located is outside the Plan area.
Surfrider Foundation	Continuation of lagoon entrance clearance is paramount	PR10 addresses entrance clearance and the need to review entrance management regimes.
	Need to investigate loss of beach sand from storm surges and the way in which entrance clearance is managed at Narrabeen, the most “at risk” beach in NSW from storm surges	Loss of beach sand from storm surges is outside of the area for the Plan. PR10 addresses entrance clearance and the need to review entrance management regimes.
	Revisit feasibility of sand pumping from a variety of locations along the beach	PR10 addresses entrance clearance and the need to review entrance management regimes.

Private

No.	Issues	Response
1 (S1)	Blocking of entrance with man made sand dune that was not there, should remove at least half of the sand dune.	Outside of the Plan area.
2 (S2)	Speed limits around Narrabeen Lagoon to be reduced for pedestrian safety	Outside of the Plan area.
	Good summary of history and issues	Noted.
3	Management actions are contradictory, confusing and offer little practical guidance, especially on critical issues such as dredging. Performance targets and measures contain too many motherhood statements which cannot be measured.	The Plan (not to be confused with a management plan) has been developed to comply with the requirements of the <i>Crown Lands Act 1989</i> and is a principles based plan. As such, the Plan is intended to be used as a tool to enable the most appropriate actions to be undertaken at the time of implementation. A very prescriptive plan may be outdated by the time there is funding to implement it. Hence, this principles based plan is designed to allow more specific action plans to be formulated when funding and resources are available (with appropriate assessment). This will not restrict management of the lagoon in the future, which is what a prescriptive plan can do.
	EP4 Protection of aquatic habitat needs to include information on how seagrass will be protected in the event of dredging	Appropriate environmental assessment required under state and commonwealth legislation would be required prior to dredging of the lagoon which would need to protect seagrass from significant impacts.
	Figure 5 indicates that the lagoon channels are closing and that there will be less flushing of freshwater. Should be accompanied by a plan showing where the areas should be deepened.	Principles-based plans do not provide this level of detail since the lagoon, as an ICOLL is an ever-changing environment. Maps, strategies and plans would be produced as part of appropriate environmental assessment for any dredging activity or other activity that may have an impact on the lagoon environment. No changes have been made.
	EP 4 cannot be met if there is dredging, as there will always be some negative impact.	Appropriate environmental assessment would be undertaken, but it is not part of the Plan's scope to provide this for specific activities that may or may not be undertaken into the future. The Plan has allowed such activities, with appropriate environmental assessment and requires consideration and balancing of all values (particularly environmental and recreational) of the lagoon. Small wording change to remove "proposed" has been completed.

No.	Issues	Response
	EP5 Monitoring and gathering of information cannot achieve the performance target to “Maintain and enhance designated aquatic habitat...”	Agreed. This measure has been amended.
	Depth changes should be shown on a map	This level of detail of information is not yet available and would be part of an environmental assessment and feasibility assessments for any dredging activity.
	Reserve Trust Manager is also Warringah Council. PR1 says that they should work together but does not include consultation with other stakeholders	Acknowledged and relevant stakeholders included in consultation.
	EP 4: Introduces an external strategy to measure the performance of the Plan	Agreed. Omitted.
	EP 4: Public recreation on the lagoon while avoiding/mitigating environmental impacts cannot be measured.	Agreed. Rewording of action has been done.
	PR 3: Does not properly measure and report on water suitable for swimming, also should have a map showing these areas. Standards would also be useful and information on flushing.	There are no designated swimming areas in the Plan as the Reserve Trust cannot guarantee that an area will have long term water quality that is suitable for swimming. There are several areas of the lagoon monitored for water quality by State Water and Beachwatch. This Information can be made available through the Reserve Trust Manager to the public. Dredging to allow water flushing would not necessarily make the water quality of the lagoon suitable for swimming. No change has been made.
	PR 4: Reference to use of water craft in this section is not appropriate and should be moved	Acknowledged and moved to “sustainable public recreation”.
	Lack of clarification of tradeoff of dredging for environmental, versus recreational purposes	The Plan acknowledges throughout that there needs to be a balance between environmental and recreational needs. The Plan allows for dredging but does not specify how and where this would occur. This is for further environmental assessment and feasibility assessments.
	What is an appropriate depth for recreation? Does not provide	This level of detail would be in an action developed under the Plan or feasibility

No.	Issues	Response
	guidance. Should show a map showing details of depth levels across the lagoon.	assessment for any change to the depth of the lagoon. Beyond the scope of this Plan.
	PR 9: Key management actions should be included in the Plan so that there is an understanding of the relationship with the two plans	Flood management plan for Narrabeen Lagoon is currently being updated at the moment. This will be undertaken and have amended this action.
	PR10 & PR11: Management actions that will not have any effect on flooding.	Reserve Trust Manager and SMEC disagree with this statement, and believe they will. However, these will be reviewed after the current flood management plan is finalised.
	Recommend legal opinion on appropriateness of “Coastal Environmental Protection” and Recreation as the new purpose of the lagoon. Conflicting management	Legal advice and consultation with DPI has been undertaken regarding the additional purpose. The difficulty of managing both environmental protection and public recreation is noted however the Plan aims to balance the two.
	- Current management plan is not actionable, and are based on community opinions from current consultation, rather than a suite of actions to ensure lagoon is managed to desired outcomes. - Management actions should draw upon scientific research and include defined actions relating to each of the key value areas identified by the community.	As stated previously, this is a principles based document and much of the management of the lagoon will depend on appropriate funding. Therefore, it lays down the principles, but not the specifics for management. This would be developed under appropriate actions and plans (Figure 5). The plan was developed following extensive consultation with not only the community but other key stakeholders.
4	No footpath for pedestrians trying to get to the Narrabeen Fitness Centre. A pathway around the whole lagoon would be great.	This is the long term plan for the area, however this is outside the area of this Plan. Please see www.warringah.nsw.gov.au for updates on the progress of this shared path. Warringah Council is in the process of designing and constructing the Narrabeen Lagoon Multi Use Trail which will complete the final links of the existing trail network along the foreshores of Narrabeen Lagoon.
5	Revise vision statement to “A lagoon rehabilitated and maintained as an aquatic system which, together with its surrounding riparian and wetland zones, supports a full complement of biodiversity and sustainable low-impact human uses.”	The vision statement in the Plan was developed through the consultative process undertaken during development of the Plan. There would be an opportunity to revisit and if considered appropriate, revise and update the vision statement during future revisions of the Plan.
	Little or no information on sediment quality is included.	EP3 addresses sediment and information in previous documents (VIOP and due diligence report) used to develop this Plan is available.

No.	Issues	Response
6	Guiding principles: “balance” may not give sufficient weight to environmental values as a priority consideration.	The Plan aims to balance both the environmental and recreational values of the lagoon. Appropriate environmental assessments must be undertaken prior to any works or activities undertaken on the lagoon.
	Recreational activities must be ecologically sustainable and should be considered as part of decision to undertake any works.	This is an essential component to decision making and approval for any action that the Reserve Trust Manager will undertake. This is covered legislatively as well as within the Plan.
	Any increases in water depth for recreation must consider environmental impacts.	Any such activity would require approval under the <i>Environmental Planning and Assessment Act 1979</i> which would require appropriate environmental assessment and consultation with stakeholders.
	Bathymetry investigations would provide further information about the lagoon environment.	Some investigation has been undertaken (eg BMT WBM (2009) <i>Narrabeen Lagoon, Central Basin Recreation Channel Dredging Feasibility Assessment</i>). Further work would be undertaken if dredging was pursued as part of management of the lagoon.
	If dissolved pollutants are likely to affect the environment/recreation some regular testing should be undertaken.	This may form part of an action plan developed as part of the Plan and is allowed for in the Plan. However this will be subject to future resources and funding.
	Primary contact recreational activities are a very important value, since Narrabeen is the only ICOLL to have this in the Sydney basin.	Noted. There are actions and targets in the Plan which address water quality in the lagoon appropriate for swimming.
	Tadpoles and frogs in upstream freshwater areas could be at risk from carp farm at headwaters of South Creek.	Noted. Although the upstream areas are beyond the scope of the Plan, the Reserve Trust Manager will work with catchment managers in preventing negative impacts to the aquatic habitat. This is discussed in the Plan.
7	There are gaps in our knowledge about the environment of the lagoon, therefore damage to ecosystems should be avoided	Noted. There are actions in the Plan relating to understanding of and protecting aquatic habitat. Actions also include the undertaking of appropriate environmental assessments prior to any works or activities undertaken on the lagoon.
	Narrabeen Lagoon not listed as one of Warringah’s natural assets, perhaps this is an action that could be pursued.	Noted. Narrabeen Lagoon is listed as a natural asset in Council's asset register. See asset #LLP00383. No change needed to document.

No.	Issues	Response
	Watersheds and hydrological features in upper catchments should be protected.	Noted. Many of the actions in this Plan call for the Reserve Trust Manager to work with surrounding land holders to protect natural areas in the catchment.
	Support the amalgamation of Narrabeen Lagoon and surrounding Crown land Reserves into a State Park.	Noted. This is provided for in the Plan.
	Plan of Management should aim to protect the environmental values of the lagoon and environs.	Noted. This Plan a step toward preservation and balance of recreational needs and environmental values.
8	AHO and Manly Warringah Pittwater Aboriginal Support Group should be approached.	Noted. The AHO, Guringai Education Consultative Group, Aboriginal Heritage Consultative Group and Metropolitan Aboriginal Land Council were all consulted during the development of the Plan. The Manly Warringah Pittwater Aboriginal Support Group will be added to the stakeholder list and notified of any future consultation.
	Mitigating highly urbanised areas of catchment is difficult.	Noted. Catchment management issues are addressed by Actions EP3 and EP9.
	Need to balance recreation for 1000 people a day versus preserving natural values. Would be good to put forward the model as “best practice”.	This has been inserted in Section 4.1.1.
	Further studies into fish population, including cornerstone species would be desirable.	Noted. See EP 5.
	Aim should be to improve condition of central and western basins and assist in halting eutrophication.	Noted. See EP 2 and EP 5.
	Increased SQUIDS would be good.	Noted. See EP1, EP2 and EP3
	Importance of area for birds and threatened species.	Noted.
	Fencing of Wakehurst Parkway.	Outside of scope of Plan. See investigations being undertaken by RTA and Northern Beaches Roadkill Prevention Committee.
	Main objective should be health of lagoon and entrance	Entrance clearance is primarily for flood mitigation, followed by water quality.

No.	Issues	Response
	clearance should be reduced if lagoon healthier.	
	Review of plan is sufficient. Should look at water quality after high rainfall.	Noted. See PR3.
	Concerned about level of rubbish and threat of eutrophication and persistent organic pollutants.	Noted. EP1, EP2 and EP3 deal with litter management and poor water quality. See Beachwatch data for Birdwood Park for information on water quality.
9	- Provides broad management concepts, rather than tailored practical and specific management actions with quantifiable goals. - No obligation to carry out any management. - Understands lack of funding, but essential goals should be set.	The Plan has been developed to comply with the requirements of the <i>CL Act</i> . Further, the Plan principles-based and as such is intended to be used as a tool to enable the most appropriate actions to be undertaken at the time of implementation. A very prescriptive plan may be outdated by the time there are sufficient resources and funding to implement it. This will not restrict management of the lagoon in the future, which is what a prescriptive plan can do.
	Plan is not a practical document for management and will require more money to be spent on more reports rather than spending on management actions. No measure for successful management.	The Plan is a strategic document that is necessary under the <i>CL Act</i> to undertake specific actions. See comment above regarding principles based Plan.
	Should be about maintaining or improving.	See Section 1.3 for further information.
	Does not require independent or external review.	Annual report is a publicly available document. Most actions will require environmental assessment which has a component of stakeholder consultation and is usually undertaken by a third party/consultant.
	Consultation Committee to meet regularly.	The Plan emphasises co-ordinated approach to management with community and stakeholder engagement (See EP3, PR6 & PR8). Specific consultation will be determined dependent on the project.
	Plan to address practical management items such as propeller damage to seagrass.	Noted. Please see EP4 & EP5 for actions relating to the protection of seagrass..
	A number of detailed points and clarifications are requested. Eg recommends use of Laxton water quality for tributaries, and	Noted. There are a number of actions (EP3, EP5 and PR4) which relate to assessment and/or measurement of water quality. The level of detail provided in this comment will be subject to the development of future monitoring programs

No.	Issues	Response
	recommends continuation for long term comparison.	which will be appropriately scoped and implemented. .
	Several ROTAP species have been recorded around the lagoon.	This falls outside of the study area, however there is reference to Smith and Smith (2009) where these are recorded.
	Historic bridge within the study area not mentioned.	Narrabeen Lake Bridge on Pittwater Road and Bridge No. 3 over Middle Creek are now discussed in Section 3.5.3.
	Maps need to refer to more up to date vegetation mapping that is available.	The vegetation mapping is sourced from the SMCMA 2010 mapping and updated from recent Council records.

APPENDIX 4: SUMMARY OF MANAGEMENT ACTIONS FROM SURROUNDING PLANS AND HOW THEY RELATE TO THE PLAN

Table A6

Key management recommendations of surrounding Plans of Management relevant to future management of the lagoon

Plan of Management	Recommendations of the Plan relevant to the management of Narrabeen Lagoon	Reference to associated Action in the Narrabeen Lagoon Plan, Table 2
Berry Reserve	▪ Manage watercourses to protect biodiversity and ecological values.	EP1, EP2 and EP3
	▪ Continue to improve controls on little and pollutant discharge with inflatable booms/nets and catchment swales on stormwater lines and ensure appropriate maintenance.	EP1, EP2 and EP3
	▪ Restore degraded watercourses.	EP1, EP2 and EP3
	▪ Investigate opportunities to further rationalize stormwater outlets.	EP3
	▪ Expand public purpose from 'Public Recreation' to 'Public Recreation & Foreshore Environmental Protection.	The public purpose of Narrabeen Lagoon (with the exception of Wimbledon Is) is Coastal Environmental Protection and Public Recreation. Admin 2 and Admin 3.
	▪ Prepare a detailed land survey of scheduled location to clarify reserve boundaries.	Admin 6
	▪ Investigate Crown reserve 'bed of the lake' encroachments.	Admin 6
Jamieson Park	▪ Catchment Management is a priority focus.	EP1, EP2 and EP3
	▪ Target ridgeline development and its associated impacts (i.e. urban run-off, altered hydrology, nutrient loading).	EP11
	▪ Focus on major stormwater lines as well as the large number of private residential drains as part of the catchment management strategy.	EP1, EP2 and EP3
	▪ Introduction of sedimentation ponds/swales, planting and gross pollutant traps.	EP1, EP2 and EP3

Plan of Management	Recommendations of the Plan relevant to the management of Narrabeen Lagoon	Reference to associated Action in the Narrabeen Lagoon Plan, Table 2
Sydney Lakeside Holiday Park	▪ Up to date chemical storage and handling procedures.	EP2
	▪ Investigate ways to separate the foreshore and the Holiday Park at peak times.	PR6
Coastal Lands	▪ Maintain and enhance natural areas and areas of recreational open space that recognise and promote the natural and built heritage of Warringah.	PR1
	▪ Continue to liaise with Sydney Water to upgrade and improve the sewer system through Council's estuary and coastal management committees.	EP2
	▪ Continue to liaise with surf life saving clubs to encourage increased and continuing broad community access to the buildings, and to undertake facility improvements and management practices.	PR1 and PR6
Dee Why Valley and South Creek Open Space Corridor	▪ Allowing new and improved sporting facilities and recreational opportunities.	PR6
	▪ Improving the overall atmosphere, appearance and usage of all the reserves.	PR1
Generic Bushland Reserves	▪ Identify opportunities to work with adjacent landholders (such as the development of partnerships or incentives, provision of education on appropriate landscaping plants, etc) to conserve buffer zones and significant habitat on adjacent land.	EP8 and EP9
Urban Bushland Reserves – Collaroy Escarpment reserves, Lionel Watts Reserve & Frenchs Forest Showground	▪ Integrate conservation planning with other management planning and maintenance programs undertaken by Council and where possible other land management agencies and utilities.	EP8, EP9, EP11
	▪ Provide interpretive signs in each reserve as appropriate.	EP8, EP9, EP11
Pittwater Ocean Beaches – North Narrabeen Rock Pool	▪ In accordance with the Master Plan (including but not limited to) Drainage and stormwater works (major, such as detention basin).	EP3
	▪ Maintenance / minor works Examples (including but not limited to) Dune stabilisation, erosion control and foreshore protection.	EP2 and EP3

Plan of Management	Recommendations of the Plan relevant to the management of Narrabeen Lagoon	Reference to associated Action in the Narrabeen Lagoon Plan, Table 2
North Narrabeen Headland Reserve	Initiate new volunteer bush regeneration groups in the area.	EP8, EP9, EP11
	Investigate and implement strategies to minimise impacts such as drainage, pollution and access.	EP1, EP2 and EP3
	To research and collate all available historical information on North Narrabeen Headland.	EP12
	Implement regeneration and revegetation programs with a focus on fauna habitat and resource trees and plants.	EP8, EP9, EP11
	Identify inappropriate uses and implement strategies to cease those activities.	PR1

APPENDIX 5: SUMMARY OF LEASING AND LICENSING PROCEDURE WITH CROWN LAND DIVISION (DPI) APPROVAL

