



Hawkesbury City Council

attachment 1
to
item 162

Upper Hawkesbury River
Coastal Zone Management Plan
Final Report - August 2014

date of meeting: 09 September 2014
location: council chambers
time: 6:30 p.m.



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Environment
& Heritage



Upper Hawkesbury River Estuary Coastal Zone Management Plan

Final Report
August 2014

HAWKESBURY RIVER
MANS FERRY

Upper Hawkesbury Estuary Coastal Zone Management Plan

Prepared for: Hawkesbury City Council

Prepared by: BMT WBM Pty Ltd (Member of the BMT group of companies)

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	Client Reference:	Coastal Zone Management Plan
<p>Synopsis: This document sets out a Coastal Zone Management Plan for the Upper Hawkesbury River. It provides a strategic framework and action plan for the future management of the Upper Hawkesbury River Estuary. It aims to redress current issues, and conserve existing values, using a range of implementation mechanisms, including planning instruments, on-ground works, and education programs. The Plan includes an indicative costing, potential funding sources, and identifies key agencies responsible for implementation and future monitoring.</p>		

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by	Issued by
0	January 8 2014	MF	MF
1	January 31	PEH	MF
2	March 25	MF	MF
4	June 2014	MF	MF
5	August 2014	MF	MF

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Executive Summary

This document sets out a Coastal Zone Management Plan for Hawkesbury City Council to implement over the next 5-10 years. It is underpinned by a range of scientific investigations as well as community and stakeholder consultation. References for earlier background investigations are included in the introduction of the present report.

<i>Goal</i>	The primary goal of the Upper Hawkesbury River Estuary Coastal Zone Management Plan is <i>“to protect and improve the values and attributes of the River, which balances the pressure for development with the conservation of natural and built features”.</i>
<i>Purpose</i>	This Coastal Zone Management Plan (CZMP) provides strategic direction and guidance on future strategic and environmental planning within the estuary and its catchment. It also <u>provides an Action Plan</u> for undertaking targeted works and other initiatives aimed at achieving the overall Goal of improving environmental conditions.
<i>Audience</i>	The primary audience of the Coastal Zone Management Plan is Hawkesbury City Council. Other stakeholders, including relevant government agencies and organisations, community groups and the general public, should also refer to this document in respect to management of the estuary.
<i>Context</i>	<p>This Coastal Zone Management Plan has been developed under the NSW Government’s Estuary Management Program in accordance with the specifications of Part 4a of the <i>Coastal Protection Act 1979</i>. It complies with the requirements of the NSW Coastal Policy 1997, and the Hawkesbury Nepean Catchment Action Plan 2013. It is also consistent with the NSW Government’s Guidelines for Preparation of Coastal Zone Management Plans.</p> <p>The study area covers the Upper Hawkesbury River between Wisemans Ferry and Yarramundi (the tidal limit of the river). From a management perspective, the study area includes the waterway of the Upper Hawkesbury River along with its tributaries, immediate riparian areas and its broader catchment area insofar as catchment development has an impact on the river. In this regard, consideration is given to the catchments of the Colo and Grose Rivers, as well as the entire Nepean River catchment, which extends as far south as Goulburn and as far west as Lithgow.</p> <p>This Plan presents a summary of the relevant environmental processes of the estuary, and their interactions with the human use and other social and economic values placed on the estuary, its foreshores, and the wider catchment area.</p>
<i>Status</i>	Following the adoption of the CZMP there is then an option for Council to submit the CZMP to the Minister administering the <i>Coastal Protection Act 1979</i> for certification. The Minister will make an assessment to determine whether to certify the CZMP by considering whether it meets the requirements of the <i>Coastal Protection Act 1979</i> and the requirements of the Guidelines for preparing CZMPs. If the Minister considers that the CZMP should be certified, Council will be advised and then publish it in the Government Gazette. At the time of publication, OEH staff had informed Council of a temporary deferral on the certification of CZMPs. It is not known when this deferral will cease.

<i>Relationship to other plans</i>	The Coastal Zone Management Plan is complementary to a wide range of planning instruments and environmental management strategies and initiatives being used currently by Council and other stakeholders. This includes the LEP and chapters within the DCP as well as Catchment-based Plans of Action.
<i>Implementation responsibilities</i>	For the majority of Actions outlined in this CZMP, the responsibility for implementation rests with the relevant departments within Hawkesbury City Council. In addition there are a number of Government agencies that are currently involved in long term management of the river. The CZMP is a strategic document that allows Council and Government agencies to work together towards the river's environmental rehabilitation and protection.
<i>Indicators for success</i>	The ultimate success of the Upper Hawkesbury River Estuary CZMP is to be gauged by its ability to meet the targets outlined in the monitoring program.
<i>Consultation</i>	Consultation with Council, other stakeholders, and the community has underpinned the development of this Plan. A separate report on this aspect of the study is available (refer to BMT WBM 2013c). A draft version of this plan was also placed on Public Exhibition.
<i>Review and amendment provisions</i>	This Plan has an indicative 5-10 year timeframe. Progress with implementation should be formally reviewed every two years. Contingency measures should be considered if progress is slow. A complete review and amendment of the Plan should occur after a minimum 5 years, and should redress outstanding issues, incorporate new environmental management practices, new scientific data, and account for any changed governance and administrative arrangements.

A long list of around one hundred management options including planning controls, on-ground works and rehabilitation, economic incentives, regulation and compliance activities, investigations and education initiatives was developed. Contributions to this list came from Council, stakeholders, the community and experience from other similar waterways. This list was assessed using a cost benefit approach that considered economic, environmental and social aspects. A selection of 39 actions were shortlisted for inclusion in the CZMP. An overview of the actions included in the CZMP is presented in Table 1-1

Table 1-1 Overview of actions included in the CZMP

Sub Plan Theme	Ref #	Actions	Focus	Priority	Cost
Water Quality	WQ1	Write a specific WSUD chapter in Hawkesbury DCP	Strategic Planning	High	Requires Council staffing and budget
	WQ2	Review and update erosion and sediment control information and requirements in Hawkesbury DCP	Strategic Planning	Very High	Requires Council staffing and budget
	WQ3	Review and update Hawkesbury DCP in relation to rural lands to incorporate best practice land management to reduce sediment and nutrient loads	Strategic Planning	Very High	Requires Council staffing and budget
	WQ4	Undertake an education program for works staff involved in sediment and erosion control	Strategic Planning	High	Allow \$15,000 for resources
	WQ5	Enforce implementation and maintenance of effective sediment controls during subdivision and building phases of all developments (including infrastructure projects)	Regulatory and Environmental Services	High	Additional compliance resources required.
	WQ6	Undertake adequate and appropriate maintenance of existing WSUD devices to maintain their effectiveness, in particular GPTs, nutrient filters and other stormwater quality improvement devices	Infrastructure Services	High	Allow \$30,000 over and above staff time

Sub Plan Theme	Ref #	Actions	Focus	Priority	Cost
	WQ7	Utilise hydrodynamic and water quality model being developed for Sydney Water to understand potential sea level rise impacts on salinity profile	Design and Mapping	High	Allow \$50,000
	WQ8	Implement an estuary health monitoring program and issue biennial report cards	Parks and Recreation	High	Additional \$45,000 per year
Aquatic and Riparian Habitat	ARH1	Continue to support the implementation of the River Health Strategy to benefit the estuary	Strategic Planning	Very High	Depends on uptake - allow \$20,000 per year
	ARH2	Prepare a species planting fact sheet for applicants and Council officers for use in development assessment of foreshore works	Parks and Recreation	Very High	Allow \$5,000
	ARH3	In accordance with the HNCAP 2013-2023, identify locations for and undertake targeted rehabilitation, creation and enhancement of estuarine and floodplain wetland communities and adjacent riparian vegetation	Strategic Planning	High	Allow \$100,000 for the first year
	ARH4	Actively support the continuation of Bush Care to assist with revegetation works on public land	Parks and Recreation	High	Allow \$20,000 per year
	ARH5	Council to contact new riparian land owners with a 'Welcome Pack' and encourage grant based rehabilitation initiatives	Strategic Planning	Moderate	Requires Council staffing and budget
	ARH6	Coordinate weed	Parks and	Moderate	Allow \$50,000

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Sub Plan Theme	Ref #	Actions	Focus	Priority	Cost
		management efforts between the County Council, Bushcare and Landcare (including Willow Warriors) and the LALC to maximise benefits for the estuary	Recreation		
Recreation and Amenity	RA1	Increase surveillance and monitoring activities on the river for pollution and dumping	Regulatory and Environmental Services	High	May require additional compliance staff (allow \$60,000)
	RA2	Employ a River Keeper	Parks and Recreation	High	Allow \$150,000 per year
	RA3	Undertake a noncompliance audit of unauthorised activities on riparian public land	Regulatory and Environmental Services	High	Up to \$100,000
	RA4	Increase opportunities for passive recreation and support current levels of active recreation	Strategic Planning and Parks and Recreation	Moderate	Highly variable depending on opportunities sought
Landuse Planning and Development	LPD1	Prepare a public fact sheet to indicate how Council will continually assess the likely impacts of development upon the natural values and sustainability of the Upper Hawkesbury River Estuary	Development Services	Very High	Requires Council staffing and budget
	LPD2	Develop education and awareness of the Action Plans within the CZMP and the way they should be applied across the organisation	Strategic Planning	Very High	Requires Council staffing and budget
	LPD3	Review and update the Hawkesbury DCP to give greater protection to estuary	Strategic Planning	Very High	Requires Council staffing and budget

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Sub Plan Theme	Ref #	Actions	Focus	Priority	Cost
		assets			
	LPD4	Audit and review of river-side caravan parks. Map caravan park locations, clearly define regulations and identify opportunities to reduce impacts. Prepare Landscape Management Plan Guidelines.	Regulatory and Environmental Services	Very High	\$30,000
	LPD5	Provide development assessment fact sheet or checklist for subdivisions	Development Services	Moderate	Requires Council staffing and budget
	LPD6	Explore the potential of working groups between Councils within the catchment in relation to landuse planning and development	Strategic Planning	High	Requires Council staffing and budget
Foreshore Protection	FP1	Prepare fact sheet on appropriate structures on river corridor.	Development Services	High	Requires Council staffing and budget
	FP2	Prepare advice fact sheets for the community on the management of foreshore land	Development Services	High	Allow \$20,000
	FP3	Review and update Hawkesbury DCP to include a new chapter on foreshore management	Strategic Planning	High	Requires Council staffing and budget
	FP4	Prepare a factsheet for website on Environmentally Friendly Seawalls in the Upper Hawkesbury River	Development Services	High	\$50,000
	FP5	Ensure that Council is following guidelines on best practice foreshore management	Parks and Recreation	High	Requires Council staffing and budget
	FP6	Undertake foreshore	Parks and	Moderate	> \$250,000

Sub Plan Theme	Ref #	Actions	Focus	Priority	Cost
		management in areas currently experiencing bank erosion and instability and areas vulnerable to this in the future.	Recreation		
	FP7	Investigate potential causes of bank erosion along the River including the impact of boating activities in partnership with landowners, boat users and relevant agencies.	Strategic Planning	Moderate	Requires Council staffing and budget
Cultural Heritage	CH1	Work with the Local Aboriginal Land Council and elders to identify opportunities to maximise benefits of rehabilitation works for cultural outcomes.	Strategic Planning	High	Allow \$30,000 for pilot project
	CH2	Protect and enhance cultural heritage values	Parks and Recreation	Moderate	Requires Council staffing and budget
Sea Level Rise	SLR1	Incorporate sea level rise considerations into infrastructure asset management and planning processes and capital works design	Infrastructure Services	Moderate	Requires Council staffing and budget
	SLR2	Map estuarine vegetation and assess vulnerabilities to future sea level rise	Strategic Planning	High	Allow \$50,000
Monitoring and Evaluation	ME1	Erosion Monitoring	Strategic Planning	High	Allow \$50,000
	ME2	MOU between agencies regarding sharing of environmental health data	Strategic Planning	Moderate	Requires Council staffing and budget
	ME3	Continue to evaluate navigability issues and dredging	Strategic Planning	Moderate	\$20,000 biennially

Sub Plan Theme	Ref #	Actions	Focus	Priority	Cost
		feasibility			
	ME4	Establish an Estuary Management Committee to guide holistic management of the estuary	Strategic Planning	High	\$10,000 per year

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1 Introduction

This document provides a suite of actions and related implementation details to be undertaken by Hawkesbury City Council (HCC), other public authorities and the community to address priority management issues affecting the sustainability and environmental health of the Upper Hawkesbury River Estuary over the next 5-10 years.

As the CZMP will guide the investment of resources in the estuary, it needs to be based on the best possible information. To date, three key reports have been prepared and the information contained within them underpins this Coastal Zone Management Plan, as listed below:

- Upper Hawkesbury River Estuary Synthesis Report (BMT WBM, 2013a)

This report collates and reviews the background information regarding the Upper Hawkesbury River Estuary, including the available scientific data, existing governance framework and management initiatives.

- Upper Hawkesbury River Bank Erosion, Foreshore Structure and Weed Mapping Report (BMT WBM, 2013b)

This report documents water-based field data collection, mapping and analysis of foreshore erosion, structures and weeds along the Hawkesbury River between Yarramundi and Wisemans Ferry. This study was prepared to facilitate the development of management options for the present Upper Hawkesbury River Estuary Coastal Zone Management Plan.

- Upper Hawkesbury River Estuary Community Consultation Report (BMT WBM, 2013c).

This report summarises the outcome of initial community and stakeholder consultation regarding the Upper Hawkesbury River Estuary. The community consultation included three community meetings, a website, survey, stakeholder workshop and telephone based discussions.

1.1 Why Develop a Coastal Zone Management Plan?

The coastal zone of NSW represents a priceless natural resource that is immensely valuable from an ecological, social and economic perspective. In addition to the open coast beaches and headlands, the NSW coastal zone contains over 130 estuaries that vary in size from small coastal creeks and lagoons to large lakes and rivers. Estuaries contain diverse ecosystems that form the foundation of the coastal food chain. They provide important habitats for a variety of marine and terrestrial plants and animals. These natural systems also provide important recreational and scenic centres for many coastal communities.

The Upper Hawkesbury River Estuary is an important component of the local landscape from a socio-economic perspective (such as commercial trawling activities and tourism activities) as well as a natural perspective (including the various species of flora and fauna that depend upon it).

Under the *NSW Coastal Protection Act 1979*, a Coastal Zone Management Plan may be prepared to address risks to estuary health through management actions to maintain, improve or protect estuary values. Therefore, HCC with assistance from the NSW Office of Environment and Heritage (OEH) resolved to prepare the Upper Hawkesbury River Estuary Coastal Zone Management Plan (CZMP) to provide strategic direction and guidance on future actions within the estuary and its

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catchment, and to preserve, improve or maintain the community and environmental values of the estuary.

The CZMP shall be used to inform other strategic documents that aim to manage and rationalise human activities and development within the catchment. The CZMP will need to be considered when assessing new developments in accordance with Section 79C of the *Environmental Planning and Assessment Act, 1979*.

This CZMP aims to fulfil Council's requirement for applying the principles of Ecologically Sustainable Development (ESD) to the Upper Hawkesbury River Estuary.

1.2 Area Covered by the Coastal Zone Management Plan

The study area covers the Upper Hawkesbury River between Wisemans Ferry and Yarramundi (the tidal limit of the river). This is a distance of around 76 kilometres. From a management perspective, the study will need to include the waterway of the Upper Hawkesbury River along with its tributaries, immediate riparian areas and broader catchment area insofar as catchment development has an impact on the river. In this regard, the relevant catchment incorporates the catchments of the Colo and Grose Rivers, as well as the entire Nepean River catchment, which extends as far south as Goulburn and as far west as Lithgow. The Macdonald River, Cattai Creek, Redbank Creek and South Creek are also included.

Also to be included in this Plan are the Nationally Important Wetlands of Pitt Town Lagoon and Longneck Lagoon. Whilst these lagoons are subject to the local Scheyville National Park and Pitt Town Nature Reserve Plan of Management (NPWS, 2000), their intermittent connection to the estuary is important, and thus their values are intrinsically linked to those of the broader estuary.

It is not intended that the CZMP be a mechanism for broad catchment management planning across this vast area, although, it is important that the issues within the catchment are taken into account in the context of the river, and that there is strong linkages between this Plan and other existing strategic documents that have a more detailed focus on catchment initiatives, including the Hawkesbury-Nepean Catchment Action Plan (2013) and the accompanying Hawkesbury Nepean River Health Strategy (2007).

Most regular users of the Upper Hawkesbury River Estuary appreciate it is a tidal system, however, the long distance (some 143km) of the tidal limit from the ocean makes it quite different to many of the other estuaries that are managed through the NSW Government Coastal Zone Management Program.

1.3 Management by Reaches

For the purpose of management planning, the study area is considered in five reaches. This approach has been taken because of the large size of the study area and also because of the diversity of conditions throughout the estuary. The study area ranges from the near natural Colo River to the highly modified reaches downstream of Windsor.

The five reaches are:

- Yarramundi to Windsor (see Figure 1-1);

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- Windsor to Sackville (see Figure 1-2);
- Sackville to Wisemans Ferry (see Figure 1-3);
- The Colo River (see Figure 1-4); and
- The floodplain lagoons (see Figure 1-5).

Detailed information about each of the reaches is included in the Synthesis Report (BMT WBM, 2013a). A summary of some of the key features is given below.

1.3.1 Yarramundi to Windsor

The Yarramundi to Windsor Reach is wide, shallow and freshwater dominated with moderate tidal influence. It receives tributary inflows from the Grose River and the Nepean River (upstream of Yarramundi). The tidal limit of the Hawkesbury River occurs at Yarramundi, approximately 140km upstream of the river mouth (Krogh *et al* 2009). Nutrient levels are often low in this reach, possibly due to uptake by the prolific aquatic weed *Egeria densa*.

1.3.2 Windsor to Sackville

The river is wide and deep through this reach, and highly utilised for water-skiing and wakeboarding. This reach has the poorest water quality with Cattai Creek and South Creek delivering flows that are frequently high in nutrients, low in dissolved oxygen and of a higher salinity than the incoming tidal flows (in this location). Bank erosion is prevalent and native riparian vegetation is sparse.

1.3.3 Sackville to Wisemans Ferry

The river remains wide and deep in this reach although the surrounding terrain steepens. The banks are often sheer sandstone cliffs characterised by native vegetation. Inflows from the Colo River deliver clean fresh water to this reach. The western foreshores are in Hawkesbury LGA and the eastern foreshores are in The Hills LGA.

1.3.4 The Colo River and Webbs Creek

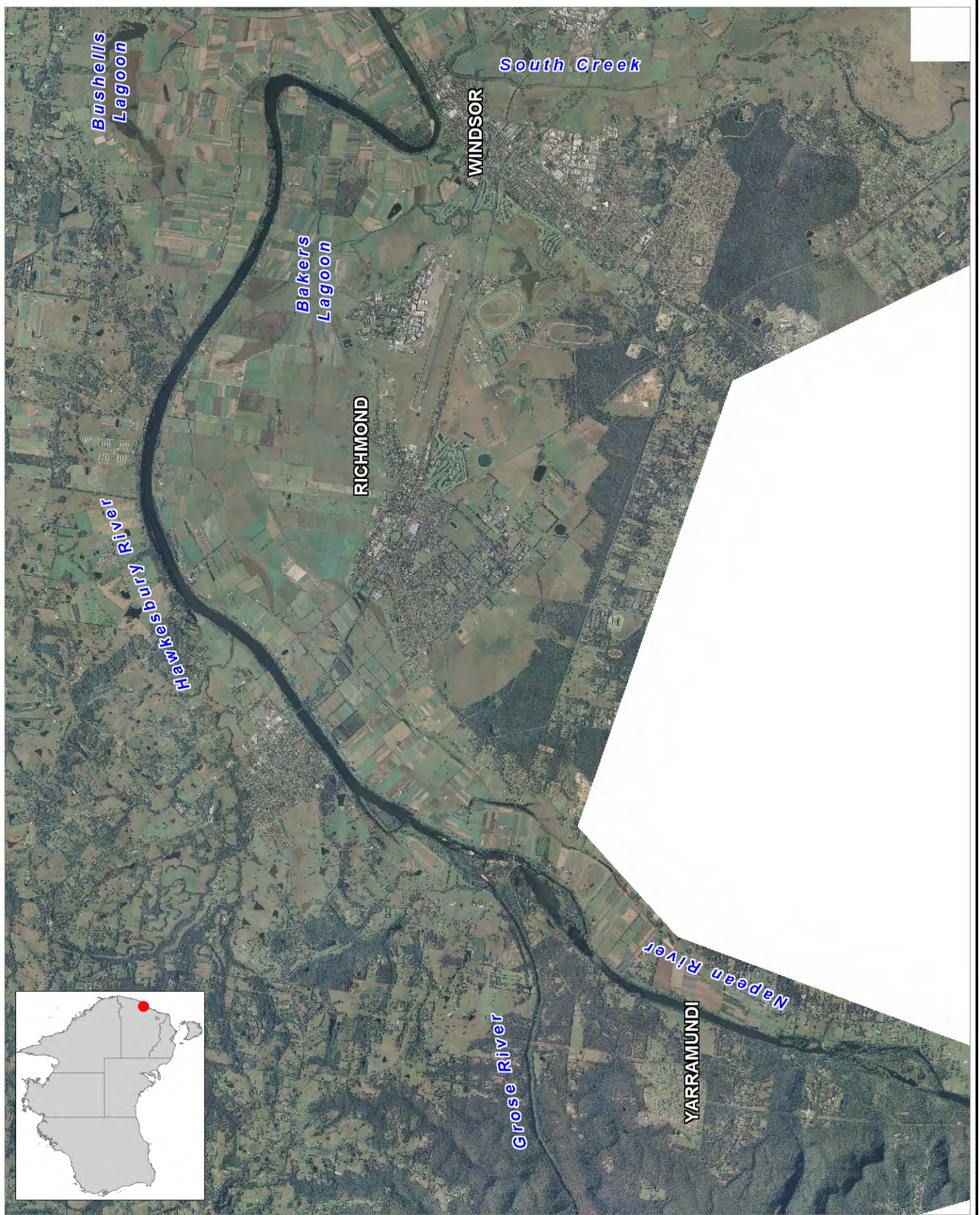
Both the Colo River and Webbs Creek have four knot speed limits for boats. These waterways are significantly less degraded than the main reaches, with the Colo River having a status of “wild river” further upstream. Webbs Creek experiences some erosion and weed invasion in the downstream reaches, however, it has a good example of natural succession from estuarine wetland vegetation to floodplain melaleuca forest. Despite the fact that the Colo River maintains basically a natural flow regime, it has shown a reduction in freshwater inputs over the last 100 years, giving some insight into long term natural variability. The Macdonald River is another tributary that is just outside the study area.

1.3.5 The Floodplain Lagoons

The public floodplain lagoons include Pitt Town and Long Neck Lagoons. Long Neck Lagoon in particular has high Aboriginal Heritage value. The floodplain lagoons provide important habitat for migratory water birds. Although predominantly invaded by carp at present, they have some

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potential for native fish habitat. A number of other floodplain lagoons exist in various tenure, including Bakers and Triangle Lane Lagoons in private ownership. Pughs and Bushells Lagoons span both public and private property.



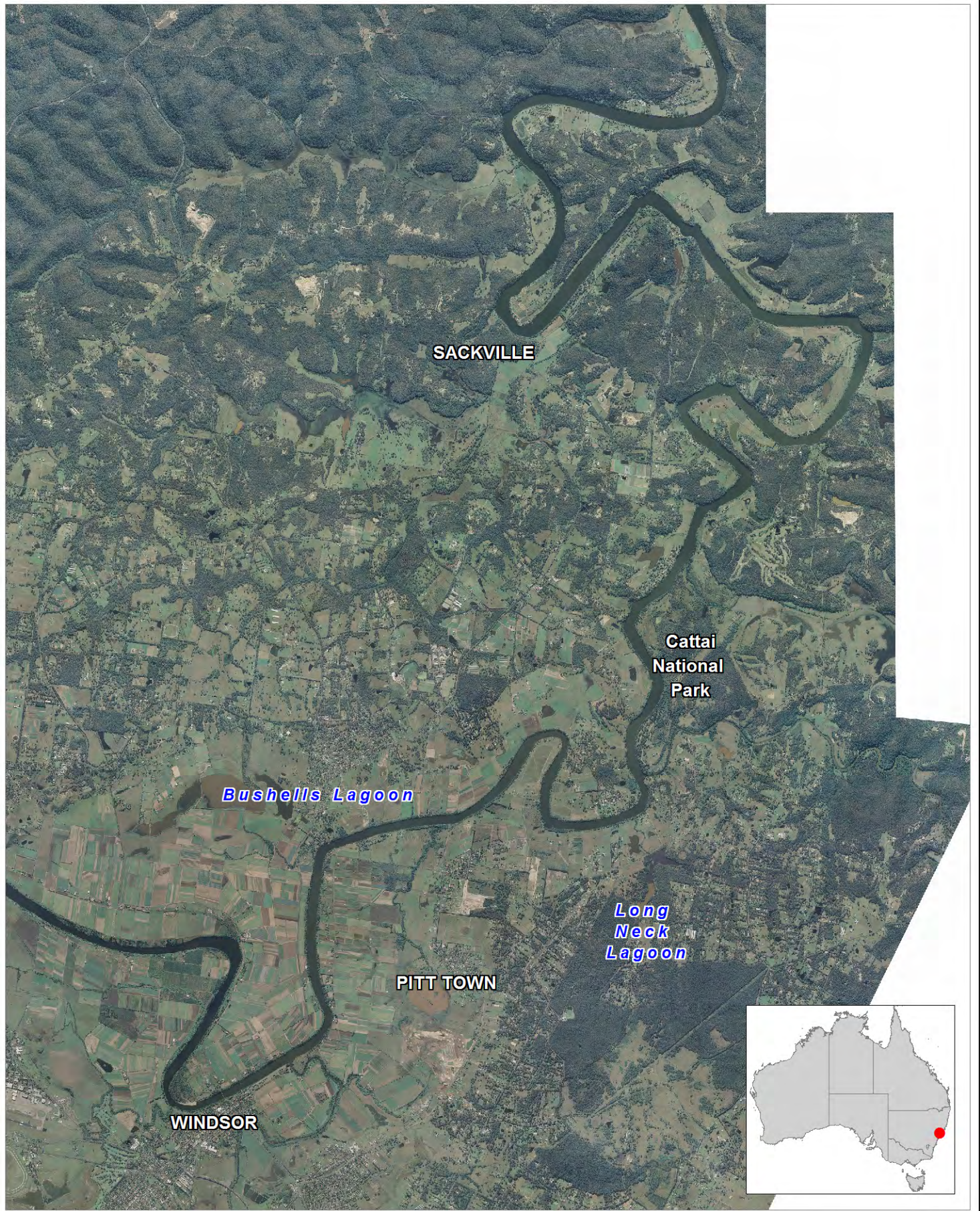
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 Yarramundi to Windsor**



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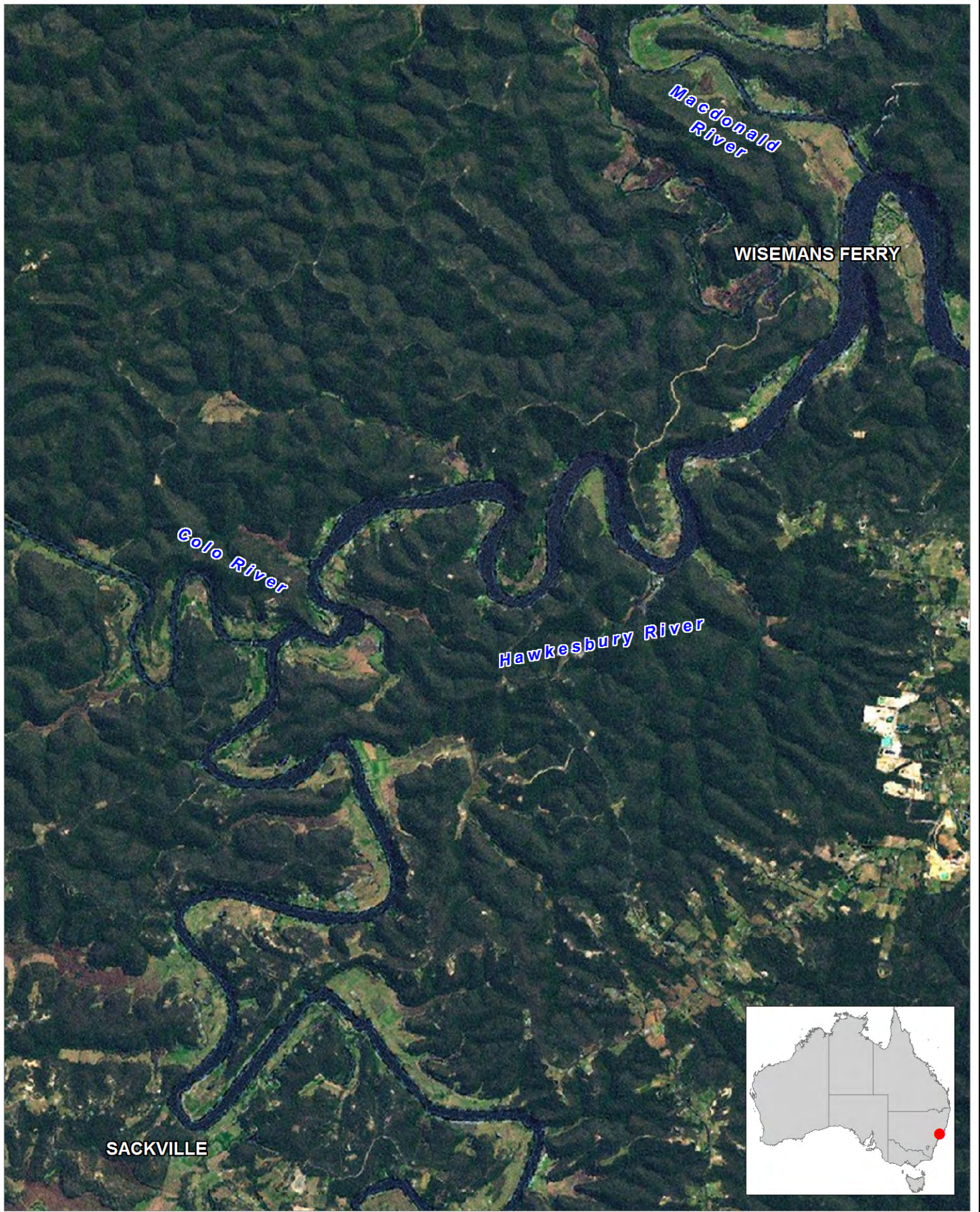
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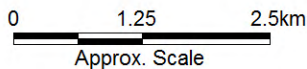


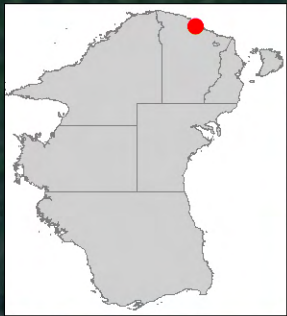
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**Upper Hawkesbury River
 Sackville to Wisemans Ferry**

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**Upper Hawkesbury River:
Colo River**

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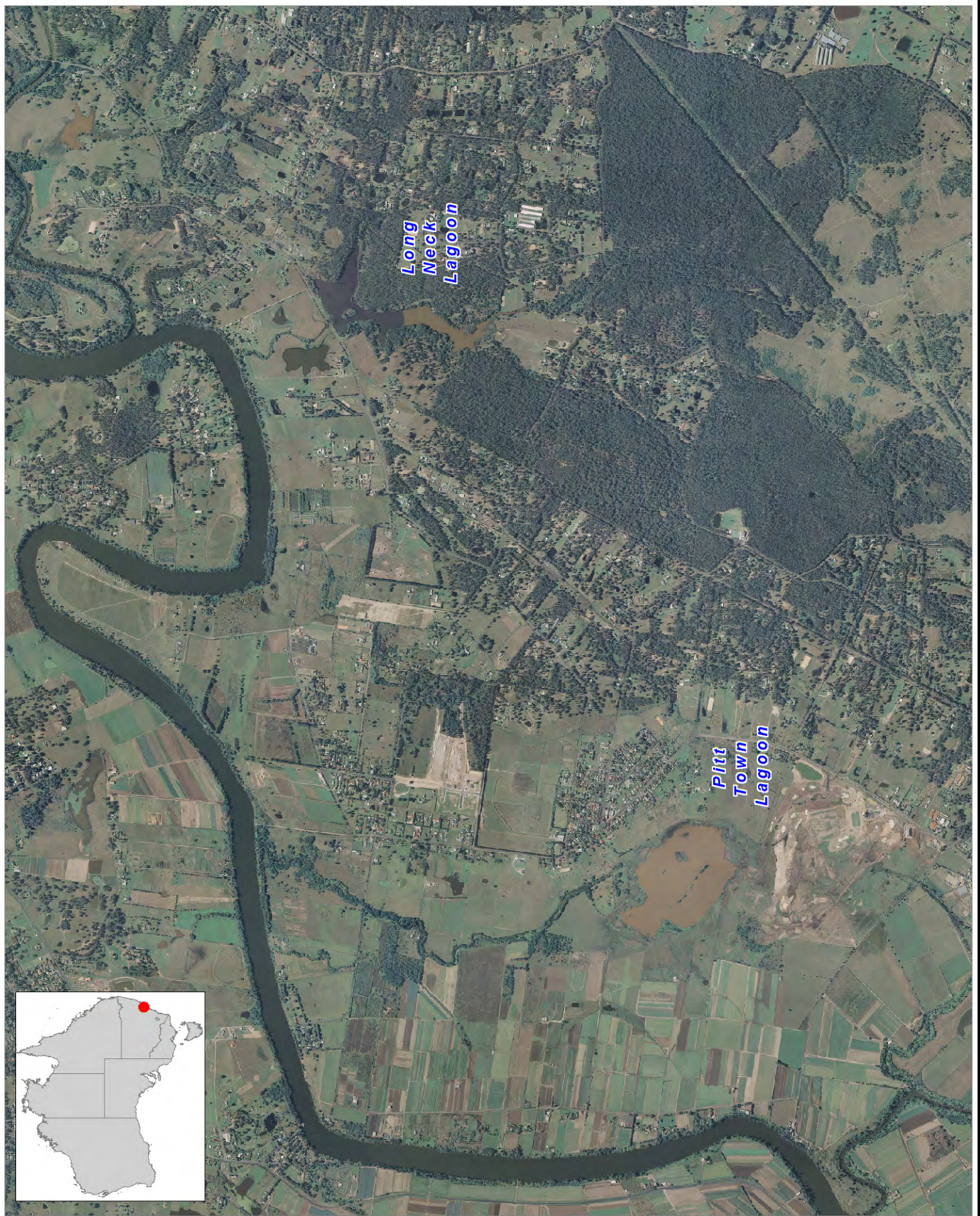
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Long Neck Lagoon

Pitt Town Lagoon

Title:
**Upper Hawkesbury River:
 Floodplain Lagoons**

Figure:
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Introduction

1.4 Coastal Management Principles

The Guidelines for Preparing Coastal Zone Management Plans (DECCW, 2010) outline minimum requirements for CZMPs. Each of these minimum requirements have been met through the development of this document.

One of the minimum requirements refers to principles that should be considered in evaluating potential coastal management actions and be reflected in draft CZMPs. As a quick reference guide, Table 1-1 outlines each of the relevant principles and how they have been addressed. Further details on the process undertaken in developing this CZMP can be found in the preceding reports (BMT WBM, 2013a, 2013c).

Table 1-1 Consideration of Coastal Management Principles in the development of the Upper Hawkesbury River Estuary CZMP

	Coastal Management Principles	Addressed by Upper Hawkesbury River Estuary CZMP
Principle 1	Consider the objects of the <i>Coastal Protection Act 1979</i> and the goals, objectives and principles of the NSW Coastal Policy 1997	The preparation of this CZMP has followed the Guidelines for Preparing Coastal Zone Management Plans that is the manual for implementation of the objectives of the Act for CZMPs. In determining the intent for management of the coastal lagoons, the NSW Coastal Policy has been considered.
Principle 2	Optimise links between plans relating to the management of the coastal zone.	By using a risk-based approach, existing controls within existing plans are reviewed and incorporated into the analysis of risk, and also used as a starting point for developing risk treatments (i.e. management options).
Principle 3	Involve the community in decision-making and make coastal information publicly available.	Comprehensive community consultation has been undertaken throughout the development of this plan. This is reported separately in the Community Consultation Report (BMT WBM, 2013c).
Principle 4	Base decisions on the best available information and reasonable practise; acknowledge the interrelationship between catchment, estuarine and coastal processes; adopt a continuous improvement management approach.	Significant investigations of the Upper Hawkesbury River Estuary have been undertaken previously. This information was summarised into the Synthesis Report (BMTWBM, 2013a). Data gaps were also identified and further investigations into priority areas of erosion, foreshore mapping and weeds were undertaken (BMT WBM 2013b). This information was combined with community consultation and further investigations to identify the community values and human pressures upon the estuary. The environmental and community values and threats to the estuary are based upon these studies and information. In accordance with the requirements of Section 55 of the <i>Coastal Protection Act 1979</i> , the Plan will be placed on public exhibition for a minimum of 21 days and provision has been made to update the Plan (as required) based on consideration of any submissions received
Principle 5	The priority for public expenditure is public benefit; public expenditure should cost effectively achieve the best practical long-term outcomes.	Cost benefit analysis for management options has recognised the public benefit as priority for management options.

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	Coastal Management Principles	Addressed by Upper Hawkesbury River Estuary CZMP
Principle 6	Adopt a risk management approach to managing risks to public safety and assets; adopt a risk management hierarchy involving avoiding risk where feasible and mitigation where risks cannot be reasonably avoided; adopt interim actions to manage high risks while long-term options are implemented.	This plan has been prepared using the ISO 31000:2009 International Standard Risk Management Principles and Guidelines. The risk based approach is an internationally recognised framework for management because it incorporates the best available information and its uncertainty. The adopted Risk Management Framework intrinsically requires ongoing monitoring of risks and review and tailoring of risk treatments (management options).
Principle 7	Adopt an adaptive risk management approach if risks are expected to increase over time, or to accommodate uncertainty in risk predictions.	The Risk Management approach incorporates both the known and possible frequency and consequence of a threat, thereby incorporating the uncertainty in the occurrence of risks / threats. The Coastal Zone Management Plan includes an ongoing monitoring and evaluation component, linked to an estuary health monitoring program.
Principle 8	Maintain the condition of high value coastal ecosystems; rehabilitate priority degraded coastal ecosystems.	The ability of a management option to provide environmental protection or benefit has formed part of cost benefit analysis of options.
Principle 9	Maintain and improve safe public access to beaches and headlands consistent with the goals of the NSW Coastal Policy.	The open coast and rocky headlands are not included in the study area. Public access to foreshore areas has been included.
Principle 10	Support recreational activities consistent with the goals of the NSW Coastal Policy.	Recreational usage is an important component of the assessment. This has facilitated the management of recreation activities in a manner that is consistent with the values of the estuary in accordance with the NSW Coastal Policy.

1.5 Potential Funding Sources

An important reason for preparing a Coastal Zone Management Plan is the ability to attract sources of additional funding. By demonstrating that a considered and informed approach has been taken in developing actions, funding organisations can be confident that resources provided will be a good investment in environmental health and sustainability. This is particularly true for the NSW Government Estuary Management Program, which is likely to be a key avenue for future funding. This Plan includes a range of potential grants and funding sources for each recommended action. Some information on potential grants is given in Table 1-2. This list of funding sources is not exhaustive and it will be important to track and identify emerging grants opportunistically during implementation of the Plan.

Table 1-2 Examples of Potential Funding Sources

Grant Name / Further Information / key dates	Details	Source
BiodiversityFUND Ongoing	<p>The Biodiversity Fund will fund projects which best target the three themes:</p> <ul style="list-style-type: none"> • biodiverse plantings • protecting and enhancing existing native vegetation • managing invasive species in a connected landscape 	Federal
Caring for Our Country Ongoing	<p>Target Area Grants will fund activities that will contribute to the achievement of the three strategic objectives of the Sustainable Environment stream of Caring for our Country:</p> <ul style="list-style-type: none"> • maintenance of ecosystems services, including ecological and cultural values, now and into the future • protection of our conservation estate • enhanced capacity of Indigenous communities to conserve and protect natural resources 	Federal
Community Action Grants	<p>Community Action Grants are a small grants component of the Australian Government's Caring for Our Country initiative that aims to help local community groups take action to conserve and protect their natural environment. The grants are targeted towards established local community-based organisations that are successfully delivering projects to support sustainable farming and/or protect and enhance the natural environment.</p> <p>Each year, investment proposals are sought from environmental, Indigenous, Landcare, Coastcare and sustainable agriculture community groups for grants of between \$5,000 and \$20,000 (GST exclusive) to take action to help protect and conserve Australia's natural resources and environment.</p>	Federal
Estuary Management Program	<p>The primary objective of the NSW Government's Estuary Management Program is to provide support to councils to improve the health of NSW estuaries and understand the</p>	State – Office of Environment and Heritage

Introduction

Grant Name / Further Information / key dates	Details	Source
Annual	potential risks from climate change.	
Environmental restoration and rehabilitation Ongoing	<p>The aim of the Restoration and Rehabilitation (R&R) program is to facilitate projects to prevent or reduce pollution, the waste stream or environmental degradation of any kind, run by community organisations and State and Local government organisations.</p> <p>Through these projects, the capacity of communities and organisations to protect, restore and enhance the environment can be improved.</p>	State – Office of Environment and Heritage
Ian Potter Foundation always open	The Ian Potter Foundation is a private Australian philanthropic foundation that makes grants for charitable purposes in Australia in areas including the environment	Private
Coles Junior Landcare Grants Program Ongoing	Through the Junior Landcare Grants Program, any school or organisation that would like to involve their students in landcare projects, in conjunction with local landcare groups, can apply for grants to assist them with the cost of their projects	Private Sector / Local Lands Services
Open Gardens Australia Ongoing	<p>Open Gardens Australia is a self-funding, not for profit organisation that promotes the knowledge and pleasure of gardens and gardening to all Australians.</p> <p>A demonstration site showing appropriate species and management approach (e.g. mowing) could be set up on private land. This could be used to educate other land owners and visitors about the estuary, its significance and appropriate practices.</p>	Non- Government Organisation
Recreational Fishing Trust Grants	Applications for regional projects, including fishing infrastructure and community based recreational fishing education projects are encouraged.	DPI Fisheries
Habitat Action Grants	Funding from the Recreational Fishing Trusts for projects that restore, rehabilitate and protect fish habitat in NSW.	DPI Fisheries

Introduction

1.6 Threats to be addressed in this CZMP

A long list of threat and issues known to be impacting on the Upper Hawkesbury River Estuary was compiled through:

- A review of previous reports, studies and workshop outcomes (reviewed through the Synthesis Report);
- Field inspections and further investigations; and
- Formal and informal discussions with a wide range of stakeholders and community members.

The issues to be targeted in this CZMP are those mostly under the influence of Council.

This list was prioritised using a risk management based approach as described in BMT WBM 2013c. The shortlist of threats to be addressed in this CZMP is briefly described below. For further detail the reader is referred to BMT WBM 2013c.

Within the implementation Tables shown in Chapter 3, the threats are referred to using alphabetical references (issue A-K).

1.6.1 Issue A : Riparian Land uses

In the context of the CZMP, the riparian landuses that will be targeted are:

- Encroachment of private development onto public land.

There is very limited public land available along the river, and encroachment of private development further reduces the opportunity for people to visit the river. Publicly owned reserves for the study area are limited, and in areas where the riverbank is publicly owned, adjacent private landholders have encroached onto private land with, for example, buildings, barbeques, access ways and gardens. Publicly owned riparian land should ideally be available for public recreation and showcase best practice land management including ecologically sensitive bank protection works and plantings of appropriate species.

- Stock access to banks.

Stock access is apparent in various locations throughout the study area. Stock access contributes to bank erosion and impacts on water quality through increased sedimentation and nutrient loading.

- Lack of appropriate riparian vegetation and deliberate clearing to increase views.

Riparian vegetation holds different values for different users of the Upper Hawkesbury River Estuary. The erosion study (BMT WBM, 2013b) emphasised the importance of riparian vegetation for bank protection. From a biodiversity and corridor perspective, healthy riparian vegetation is essential. Riparian vegetation also has an important role in providing fish habitat including provision of snags and insect drops for food. Riparian lands therefore form an important connection to the aquatic food chain. Snags contribute to fish habitat by creating relatively still areas and zones of decreased, variable altered flow. This variability provides resting places for fish away from strong currents and predators.

Views to the water are highly regarded and some people deliberately clear vegetation to facilitate this. Mapping undertaken for this project showed that erosion sites were predominantly

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characterised by riparian vegetation that was mostly cleared (39%) or absent (34%) from the riverbank

1.6.2 Issue B : Water Based Development

In the context of the CZMP, the water based developments that will be targeted are foreshore structures such as jetties, stairs/ladders, bank protection works and boat ramps. Issues include:

- Landowners with eroding banks to first consider options for stabilisation. Options to be initially considered include native and estuarine vegetation, with or without a temporary structure to protect it during establishment.
- If improperly designed, structures can exacerbate natural bank erosion and/or create gross pollutants/waterway hazards as components break-off during high river flow conditions (e.g. a flood).
- Construction can involve removal of riparian vegetation.
- Some structures can also impact on fish habitat and passage and reduce the waterway available to professional trawling activities.
- About 96% of structures are located downstream of Windsor, most of these are retaining walls more than three years old.
- There is significant opportunities for improving the environmental value of existing retaining walls by establishing estuarine vegetation directly in front of seawalls, providing a native riparian vegetation buffer landward of the seawall, providing artificial reef habitat immediately in front of seawalls and providing a varied surface for habitat. Another key focus of the CZMP will be to provide information to potential proponents on the most appropriate design for future structures.
- The ad-hoc nature of structures built to no specific standard results in an impact to visual amenity.

1.6.3 Issue C: Catchment Land Uses

In the context of the CZMP, the catchment development that will be targeted is:

- Poor water quality from South Creek and Cattai Creek Catchments.

The North West and South west growth centres are both located predominantly in the South Creek catchment. South Creek water quality is very poor and can sometimes act as a barrier to fish passage. Water quality monitoring and interpretation is detailed in the Synthesis Report.

- Subdivision of previously rural and agricultural land into residential urban blocks, loss of market gardens.

Urban growth centres include those to the north west and south west. In particular, urban development has the potential to contribute significant sediment loads to the estuary during the construction phase. Typically this would then reduce once construction is completed. In the longer term an increase in hard stand areas, reduced infiltration and increased velocities would continue to supply a greater quantity and poorer quality of water to the river than a natural land use. With

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Careful planning and development controls there may even be the opportunity to improve outcomes for the estuary during the move from agricultural to residential land uses.

- Agriculture (including turf farming)

Agricultural land uses contribute diffuse runoff that is characteristically high in nutrients, turbidity and sometimes pesticides.

Nutrient rich runoff is likely to contribute to algal growth and the proliferation of aquatic weeds such as *Egeria densa*.

- Present and future mining activities.

There are concerns within the community about the potential for future mining developments within the catchment and the impacts these may have on the waterway. It will be particularly important that the intentions of the CZMP as well as the Coastal Management Principles defined in Table 1-1 are considered in any proposed new mining or exploration developments within the catchment.

1.6.4 Issue D : Weed Invasion in Riparian Areas

In the context of the CZMP, the aspects of weed invasion that will be targeted are:

- Coordination of the many groups already working on the significant issue of weed invasion to increase efficiency in weed management.
- Pilot projects for emerging weeds.

Mapping of the emerging species, the Giant Reed (*Arundo donax*) has been undertaken for the present project indicating that it is most prolific between Sackville and Wisemans Ferry and particularly downstream of the confluence with the Colo River.

- Weed invasion displaces natives, reduces habitat value and weed species often have a lesser capacity to protect eroding banks than natives.

1.6.5 Issue E : Illegal dumping of waste

- This includes fill, crushed rock, rubbish and other waste materials. These materials have the potential to impact on ecology, increase sedimentation rates and create contaminated sites.
- Compliance activities along the river from Hawkesbury City Council have declined in recent years and this may have increased dumping activities.

1.6.6 Issue F: Sea Level Rise

The predicted impacts on the Upper Hawkesbury Estuary associated with sea level rise that the CZMP will focus on are:

- Exacerbation of impacts already being experienced in response to massive reductions in freshwater flows.

Under natural conditions, salinity of 5ppt would be exceeded about 12% of the time, with restricted environmental flows this level is now exceeded 35% of the time. With sea level rise, and in the absence of an increase in fresh water flows, exceedence of the 5ppt concentration will be experienced more frequently (Kimmerikong, 2005).

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- Increased volume and salinity of tidal flows on ecology.

This would include an upstream and landward migration of the mangrove limit (near Webbs Creek at present), increased saline inundation of freshwater backswamps, and changes in associated distribution of aquatic organisms.

- Unless a commensurate increase in environmental flows is adopted, sea level rise will decrease the availability of freshwater for agricultural extractors.

1.6.7 Issue G: Sediment Supply

- Managing sediment input at the source.

Local sources of sediment to the estuary include agricultural land, urban development zones, ad-hoc dumping, stream bank erosion, landscaping and catchment erosion. The CZMP will have a focus on reducing sediment supply to the estuary at the source through mechanisms such as introducing Water Sensitive Urban Design (WSUD) planning initiatives, sediment and erosion control, compliance and educational activities and improvements to stormwater management.

- Dredging is generally desired by (some) community, but recent specialist investigations by coastal engineers from Worley Parsons (refer BMT WBM 2013a) do not support dredging.
- Impacts of high suspended sediment load on ecology.

High suspended sediment within the estuary can reduce biological activity by reducing light and impacting on benthos. There is flow on impacts for all ecological processes as well as potential economic impacts for the commercial fishing operators.

- Some pollutants can attach to fine sediments

Downstream of the South Creek inflow, sediments have high levels of total organic carbon, total nitrogen and total phosphorus.

1.6.8 Issue H : Boat Based activities

- Water skiing is a long established recreational activity in the study area and is likely to be a feature of the waterway into the future;
- Water skiing is important for the local economy and the study area hosts important races including the Bridge to Bridge ski race and boat race;
- Wake boarding and water skiing can contribute to bank erosion, and there is no limit on the number of boats using the estuary at any one time;
- Waterskiing and wakeboarding need to be managed appropriately to ensure they can be activities enjoyed on the waterway into the future; and
- Other boat based activities include commercial fishing, prawn trawling and eeling and ferry operations.
- Boating, wake boarding and water skiing can also cause noise issues.

1.6.9 Issue I : Private Ownership of Foreshore Land

- Bank Condition.

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The vast majority of riparian lands are in private ownership and land owner engagement will be essential to implementing on ground works to protect banks and re-establish native riparian vegetation. It is very important that private landholders protect existing native vegetation and where possible re-establish appropriate native vegetation.

- Landscape perspective.

Private ownership has historically limited visitation by knowledge holders to assess the potential Aboriginal values of the landscape.

- Access and recreational uses.

Private land ownership restricts passive use of the estuary as there are very few locations available for picnickers or launching boats.

1.6.10 Issue J : STP Discharges

- Improvement potential.

The potential for upgrades to STP processes and plants to improve water quality have been demonstrated through the long term water quality monitoring program. Opportunities to lobby Sydney Water and others (including the waste group within Hawkesbury Council) to continue with improvements will be considered in the CZMP.

- Commercial Fishing Concerns related to impacts on habitat.
- Nutrient, salinity and common medications are three key concerns.

1.6.11 Issue K: Water Extraction and Dams

- Large scale modification of the estuarine system.

Through modification of the hydrological regime, water extraction and dams would have flow on impacts for virtually every environmental process in the study area.

- Barriers to fish passage.

HCC LGA has 25 sites identified as barriers with 12 recommended for remediation and 9 as high priority (DPI, 2006).

- Reduced flow rates increase the likelihood of algal blooms.
- The dam wall locks up a significant volume of sediment and some areas upstream of Windsor are reportedly widening in response to this (Kimmerikong, 2005).

1.7 Status of CZMP

Following the adoption of the CZMP there is then an option for Council to submit the CZMP to the Minister administering the *Coastal Protection Act 1979* for certification. If the Minister considers that the CZMP should be certified, Council will be advised and then publish it in the Government Gazette. At the time of publication, OEH staff had informed Council of a temporary deferral on the certification of CZMPs. It is not known when this deferral will cease.

2 Prioritisation of the Long List of Possible Management Options

A list of possible Management Options were developed through the earlier stages of the CZMP (refer to BMT WBM 2013a, 2013b, 2013c). These options were initially circulated with key personnel at HCC for preliminary comment and consideration.

The possible Management Options identified utilise a variety of implementation mechanisms that operate from different aspects of Council governance. Types of Management Options considered include:

- planning controls and policies;
- economic incentives and cost sharing arrangements;
- regulation and compliance;
- on-ground works and rehabilitation;
- investigation;
- monitoring;
- research; and
- education and public relations.

2.1 Multi Criteria Assessment of Management Options

A multi-criteria rapid assessment tool was developed to assess the positive and negative costs and benefits of the various options. These costs and benefits consider more than the technical merits of the options (i.e. total potential), by including aspects such as cost, timeframe, community acceptance, ease of implementation, and 'no regrets' (refer below).

The rapid assessment tool is based on a "traffic light" colour system for a range of variables, to clearly display if an aspect of an option should be cause to "stop" and reconsider, "slow" to proceed with caution or "go" with few trade-offs expected. The assessment has been conducted for each possible Management Option. It is aimed at presenting quickly and clearly the benefits and trade-offs of a particular option, to assist in the selection of preferred options.

The criteria for the assessment of the variables in provided in Table 2-1, while the results of the assessment for all potential management options are given in Appendix A.

2.1.1 Identification of Quick wins or 'No Regrets' Options

Potential management options have also been considered based on whether they are considered to be 'no regrets' actions or not. 'No regrets' refers to options that should be implemented irrespective of the specific outcomes to the Upper Hawkesbury River Estuary, as they generally are beneficial to the broader community, and involve little or no trade-offs. These options involve on-going compliance, education and further investigations aimed at improving resilience to threats imposed on estuarine health, and increasing preparedness and decision-making ability for broader

Prioritisation of the Long List of Possible Management Options

environmental risks now and in the future, such as climate change. In general, implementation of all 'no regrets' options should be pursued as part of normal day-to-day duties by HCC and other relevant management authorities.

2.2 Results of Prioritisation

Based on the multi criteria assessment, 39 options were found to potentially provide the greatest benefit to estuary health and overall environmental sustainability.

Implementation schedules for each of these options is provided in the Action Plan, presented in the following chapter of this report.

The Action Plan has been organised into eight sub plans. The Sub-Plans have been designed to allow quick reference of actions according to the key focus. The Sub-Plans are:

- Water Quality Sub-Plan
- Aquatic and Riparian Habitat Sub-Plan
- Recreation and Amenity Sub-Plan
- Land Use Planning and Development Sub-Plan
- Foreshore Protection Sub-Plan
- Cultural Heritage Sub-Plan
- Sea Level Rise Sub-Plan
- Monitoring and Evaluation Sub-Plan

The Implementation Schedules also identify the 'approach' of option, indicating the department or section of the Council that would nominally be given the responsibility for implementation (with assistance from other agencies as appropriate). These include:

- Strategic Planning
- Parks and Recreation
- Infrastructure Services
- Regulatory and Environmental Services
- Development Services
- Information Services
- Design and Mapping
- Waste Management
- Customer Service

Table 2-1 Multi Criteria Assessment Tool

	Address High Level Threat	Effectiveness / Risk Reduction Potential (RRP)	Time frame	Cost	Practicality / Legal	Community Support	Certainty of outcome
STOP & reassess	No	Option does not provide an effective and long term solution. Risk reduction potential is relatively low	LONG Term (> 5-10yrs before tasks can commence). Requires prior commitment of funds, resources or other tasks to be completed first	High (\$300K to millions)	LOW: Will require approval to implement and significant community engagement. There is a residual risk that approval will not be able to be obtained for the proposed works/strategy. Works may also require significant resources that are presently unavailable	LOW: Unlikely to be acceptable to community and politically unpalatable. Extensive community education, endorsement by Minister(s) and Council required.	The option is likely to result in a negative change or maintain present levels of the target indicator
SLOW	Partially	Option is considered worthwhile, but does not necessarily help with long term sustainability and estuary health.	MEDIUM Term (> 2 – 5yrs before tasks can commence). Requires prior commitment of funds, resources or other tasks to be completed first	Medium (e.g. \$30,000 - \$300,000)	MEDIUM: May require approvals to be implemented, but works are generally supported. Generally these approvals would likely to be granted assuming requirements are met. May require some resources that would require redistribution of existing tasks and duties by officers.	MEDIUM: Would be palatable to some, not to others (50/50 response). Briefing by Councillors, GM and community education required	The option will result in a small but measurable improvement to indicator
GO	Yes	Option provides an effective long term solution	SHORT Term (tasks can commence within approximately 2 years). Generally can be completed without too many barriers	Low (< \$30,000)	HIGH: No or minimal approvals or other impediments required to implement. No significant additional resources required (can be done as part of normal duties)	HIGH: Is very politically palatable, acceptable to community. Minimal education required	The option will result in a significant improvement to indicator

3 Action Plan

As well as a description of the works involved, their location and the implementation details for the High Priority Actions are provided herein identify locations within the LGA for the various works, where relevant. The details also cover any relevant linkages to existing initiatives, commencement timeframes, cost and resource requirements, and mechanisms for measuring the success of the option outcomes.

It is considered impractical to attempt to implement all the Actions concurrently, and as such, only the highest priority Actions are specified within the Action Plan. Notwithstanding, further details on remaining options are provided in Appendix A, where relevant and available. These options / strategies should be considered during the future reviews of this Coastal Zone Management Plan.

The implementation details also identify the 'focus area' of each action, indicating the department or section of the Council that would nominally be given the responsibility for implementation. These focus areas are:

- Development Services;
- Strategic Planning;
- Regulatory and Environmental Services;
- Customer Service;
- Infrastructure Services;
- Design and Mapping;
- Parks and Recreation; and
- Waste Management;
- Information Services.

The Action Plan has been separated into the eight (8) key sub-sections that reflect the different aims of the Coastal Zone Management Plan. These sub-sections of the Action Plan in effect represent 'sub-plans', and cover:

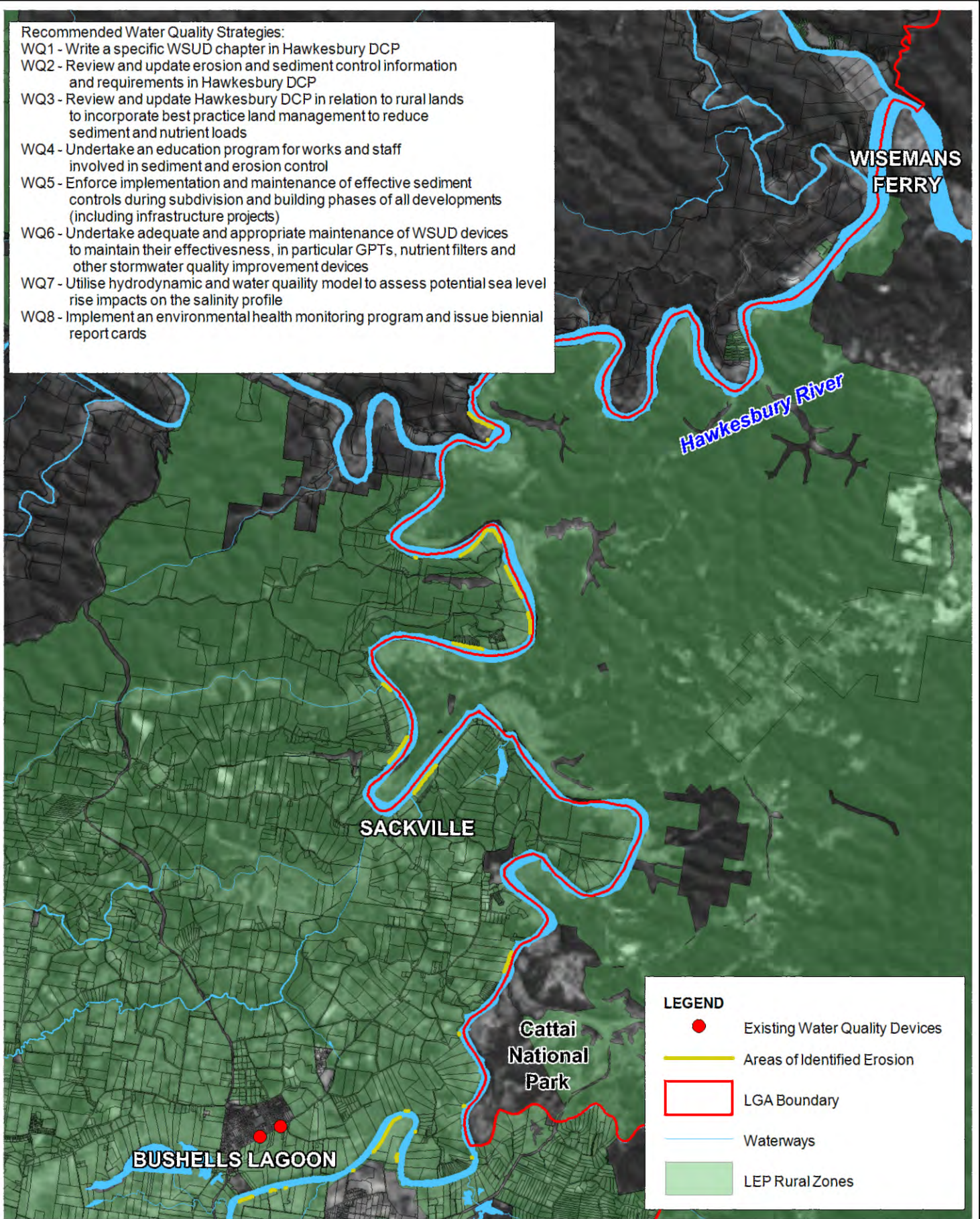
- Water Quality;
- Aquatic and Riparian Habitat;
- Recreation and Amenity;
- Landuse Planning and Development;
- Foreshore Protection;
- Cultural Heritage;
- Sea Level Rise; and
- Monitoring and Evaluation.

3.1 Water Quality Sub-Plan

WATER QUALITY SUB-PLAN

Recommended Water Quality Strategies:

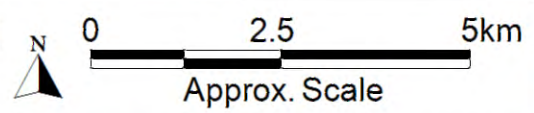
- WQ1 - Write a specific WSUD chapter in Hawkesbury DCP
- WQ2 - Review and update erosion and sediment control information and requirements in Hawkesbury DCP
- WQ3 - Review and update Hawkesbury DCP in relation to rural lands to incorporate best practice land management to reduce sediment and nutrient loads
- WQ4 - Undertake an education program for works and staff involved in sediment and erosion control
- WQ5 - Enforce implementation and maintenance of effective sediment controls during subdivision and building phases of all developments (including infrastructure projects)
- WQ6 - Undertake adequate and appropriate maintenance of WSUD devices to maintain their effectiveness, in particular GPTs, nutrient filters and other stormwater quality improvement devices
- WQ7 - Utilise hydrodynamic and water quality model to assess potential sea level rise impacts on the salinity profile
- WQ8 - Implement an environmental health monitoring program and issue biennial report cards

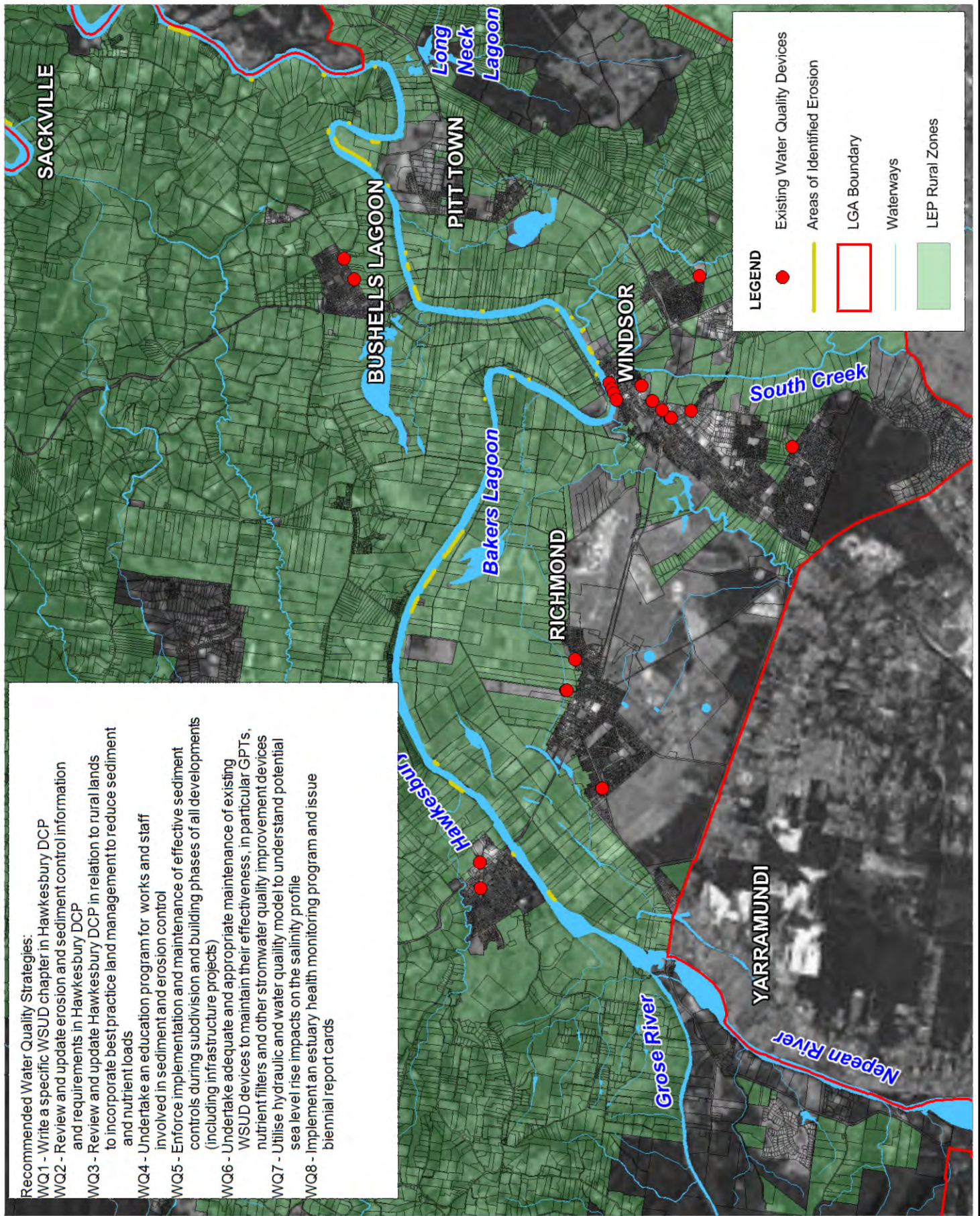


Title: **Water Quality Sub-Plan: Upper Hawkesbury River (lower reaches)**

Figure: **3-1** Rev: **C**

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





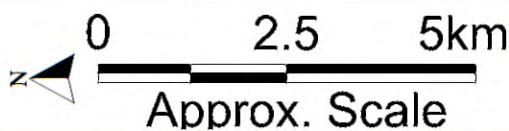
- Recommended Water Quality Strategies:
- WQ1 - Write a specific WSUD chapter in Hawkesbury DCP
 - WQ2 - Review and update erosion and sediment control information and requirements in Hawkesbury DCP
 - WQ3 - Review and update Hawkesbury DCP in relation to rural lands to incorporate best practice land management to reduce sediment and nutrient loads
 - WQ4 - Undertake an education program for works and staff involved in sediment and erosion control
 - WQ5 - Enforce implementation and maintenance of effective sediment controls during subdivision and building phases of all developments (including infrastructure projects)
 - WQ6 - Undertake adequate and appropriate maintenance of existing WSUD devices to maintain their effectiveness, in particular GPTs, nutrient filters and other stormwater quality improvement devices
 - WQ7 - Utilise hydraulic and water quality model to understand potential sea level rise impacts on the salinity profile
 - WQ8 - Implement an estuary health monitoring program and issue biennial report cards

Title:
**Water Quality Sub-Plan:
 Upper Hawkesbury River (upper reaches)**

Figure:
3-2

Rev:
C

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



WQ1	Write a specific WSUD chapter in Hawkesbury Development Control Plan											
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K	
Suggested by	Study Team						Priority	High (No Regrets)				
Focus Area / Approach Category	Strategic Planning						Applicable to	All study zones (Estuary wide)				
Detailed Description	<p>Water Sensitive Urban Design (WSUD) is an approach to urban planning that integrates land and water planning and management into urban design. WSUD is based on the premise that urban development and redevelopment must address the sustainability of water. It can include a range of approaches to improve water quality through the stormwater network such as wetland filters and grass swales.</p> <p>Water Sensitive Urban Design is one of the key management measures that can control pollutants, such as nutrients, sediments, pathogens and gross pollutants, being exported into the estuary from urban lands.</p> <p>It is recommended that Council specifies and applies pollution reduction targets within their Development Control Plan. Council should accompany this with a WSUD policy, which advocates WSUD as a means to help achieve proposed pollution reduction and improve the quality of inflows entering the Hawkesbury River and the broader Estuary (especially nitrogen, phosphorus and suspended sediments).</p> <p>In implementing WSUD, consideration must be given to the most appropriate devices and treatments trains for each situation and location. Consideration should include both the upfront and ongoing cost of options, as well as practical constraints to the implementation of specific options in different circumstances.</p> <p>Modelling tools such as the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) can be used at different scales (catchment versus project scale) to assist in deciding on what treatment trains could best meet the targets while still optimising the use of available budgets.</p> <p>Consideration should be given to whether WSUD could be designed and located to capture specific known pollution sources such as the first flush of runoff from priority roads.</p> <p>Council should consider developing specific WSUD planning controls for infill development and greenfield developments to meet the water quality targets and incorporating these in planning policies. All State Authorities should give regard to the WSUD DCP for any public development works.</p>											
Links to existing works	<p>WSUD Technical Guidelines for Western Sydney (www.wsud.org)</p> <p><i>Water Sensitive Urban Development: Model Planning Provisions</i> prepared on behalf of the Lower Hunter and Central Coast Environmental Management Strategy.</p> <p>HNCAP 2013 Sydney Landscape Management Target 1: By 2023 implement Water Sensitive Urban Design to reduce catchment inputs and improve or maintain condition of waterways</p>											
Commencement	2015, to be completed and adopted ASAP											
Costs, Resources and Funding Opportunities	Works associated with this action would be carried out by Council staff.											

WQ1	Write a specific WSUD chapter in Hawkesbury Development Control Plan
Lead Responsibilities	Council
Support Responsibilities	OEH, DPI, GSLLS
Performance Measures	<ol style="list-style-type: none"> 1. Inclusion of specific WSUD provisions within adopted Councils DCP 2. Inclusion of WSUD principles within other Council plans and policies. 3. WSUD measures included within new and infill developments, as per the DCP requirements.

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

WQ2	Review and update erosion and sediment control information and requirements in Hawkesbury DCP										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Synthesis Study					Short-listed Priority		Very High			
Focus Area / Approach Category	Strategic Planning					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>Section 4.3 of the DCP outlines guidelines for earthworks and erosion control. This chapter should be expanded to include diagrams and examples of best practice sediment and erosion control.</p> <p>All builders should be required to prepare an erosion and sediment control plan. The plan will need to be prepared before works start and submitted as part of the development application. The Plan should show how the proponent will prevent stormwater pollution throughout the construction phase and until the site landscaping has been completed. Different controls might be necessary at different stages over the construction phase as the nature of the site changes, e.g. changing drainage patterns, moving stockpiles to different places, etc. If such changes are likely, these must be shown on the Plan. Sediment and Erosion Control Plans can include notes and diagrams.</p>										
Links to existing works	<p>HNCAP 2013 Sydney Landscape Management Target 1: By 2023 implement Water Sensitive Urban Design to reduce catchment inputs and improve or maintain condition of waterways</p> <p>Landcom (2004) Soils and Construction - Bluebook</p>										
Commencement	2015, liaise with The Hills Shire Council pending finalisation of the CZMP for consistency										
Costs, Resources and Funding Opportunities	Works associated with this action would be carried out by Council staff. This requires Council staffing and budget.										
Lead Responsibilities	Council										
Support Responsibilities	HRCC, DPI, GSLLS										
Performance Measures	<ol style="list-style-type: none"> 1. Inclusion of specific sediment and erosion control provisions within Councils DCP. 2. Sediment and erosion control measures included within new developments, as per the DCP requirements. 3. Compliance to new DCP provisions 										

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WQ3	Review and update Hawkesbury DCP in relation to rural lands to incorporate best practice land management to reduce sediment and nutrient loads										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Synthesis Study					Short-listed Priority		Very High			
Focus Area / Approach Category	Strategic Planning					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>This action aims to incorporate best practice land management, stock management, fertiliser and pesticide use, erosion controls and runoff controls in order to reduce sediment and nutrient loads from rural parcels of land to the Upper Hawkesbury River Estuary.</p> <p>The Hawkesbury DCP 2002 currently only focuses on rural lands in relation to sewage management systems.</p>										
Links to existing works	<p><i>Protection of the Environment Operations Act 1997</i> Stock and Waterways (Land and Water Australia, 2006)</p>										
Commencement	2015, pending finalisation of the CZMP										
Costs, Resources and Funding Opportunities	Works associated with this action would be carried out by staff from HCC. Requires Council staffing and budget.										
Lead Responsibilities	Council										
Support Responsibilities	HRCC, GSLLS										
Performance Measures	<ol style="list-style-type: none"> Inclusion of specific provisions relating to best practice management on rural lands within Councils DCPs. Implementation of best practice land management included within new developments, as per the DCP requirements. 										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

WQ4	Undertake an education program for works staff involved in sediment and erosion control											
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K	
Suggested by	Study Team – success elsewhere					Short-listed Priority		High				
Focus Area / Approach Category	Strategic Planning					Applicable to		All study zones (Estuary wide)				
Detailed Description	<p>Undertake a detailed education program for Council works staff involved in sediment and erosion control within the catchment to raise the profile of best practice erosion and sediment control, vegetation management and assist staff with new policies and procedures. Specifically:</p> <ul style="list-style-type: none"> • Establish current levels of knowledge and audit practices in sediment control for Council and contractor staff working on roads within the catchment; • Identify the areas where awareness can be improved; • Implement a training and awareness program; and • Follow up with regular (possibly annual) audits and knowledge assessments to monitor success and to ascertain when further training and awareness may be required. 											
Links to existing works	Tucker (2011) Building staff capacity: the key to erosion and sediment control NSW Coastal Conference Proceedings											
Commencement	2015, to be adopted and completed ASAP											
Costs, Resources and Funding Opportunities	This initiative would be carried out by Council to bring skill levels in line with increasing environmental standards for sediment control. Currently there is training in road side vegetation management – a similar approach could be used for sediment and erosion control. A private facilitator may be required. Allow \$15,000											
Lead Responsibilities	Council											
Support Responsibilities	GSLLS											
Performance Measures	<ol style="list-style-type: none"> 1. Certification of the delivery of training following completion by works staff. 2. Regular inspection of Council work sites and reporting of performance to implement sediment and erosion control practices. 3. Comparison of before and after training of staff knowledge and its application 											

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

WQ5	Enforce implementation and maintenance of effective sediment controls during subdivision and building phases of all developments (including infrastructure projects)										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Study Team					Short-listed Priority		High			
Focus Area / Approach Category	Regulatory and Environmental Services					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>Council should increase compliance activities for erosion and sediment controls associated with development. This may require employing an additional staff member. Audits should be carried out during subdivision and building phases of all developments (including infrastructure projects). This includes undertaking regular audits of developments during construction.</p> <p>Once sediment and erosion control plans are required through the DA process, as described in WQ2, audits of implementation of these plans can be targeted.</p> <p>The impact of compliance activities to modify behaviour around sediment and erosion control of building sites is different for each community. To facilitate adaptive management and inform future resource allocation for the estuary a monitoring program could be implemented to assess the impact of compliance activities on behaviour and environmental outcomes.</p>										
Links to existing works	<p><i>Protection of the Environment Operations Act 1997</i> Landcom (2004) Soils and Construction - Bluebook</p>										
Commencement	2-5 years										
Costs, Resources and Funding Opportunities	This action would be carried out by Council officers.										
Lead Responsibilities	Council										
Support Responsibilities											
Performance Measures	<ol style="list-style-type: none"> 1. Increased Council resources dedicated to enforcing compliance with erosion and sediment controls 2. A demonstrable improvement in behaviour regarding erosion and sediment controls, as established through an increase in compliance to audits. 										

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WQ6	Undertake adequate and appropriate maintenance of existing WSUD devices to maintain their effectiveness, in particular GPTs, nutrient filters and other stormwater quality improvement devices										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Study Team					Short-listed Priority		High			
Focus Area / Approach Category	Infrastructure Services					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>Inadequate maintenance is a common failing of stormwater treatment devices. For example, gross pollutants stored in a wet holding area will experience organic decomposition, with depleted oxygen levels. Under these conditions, pollutants can become bio-available potentially creating algal problems in downstream sections of the waterway.</p> <p>This action involves undertaking adequate and appropriate maintenance of existing WSUD devices to maintain their as-designed effectiveness, in particular GPTs, nutrient filters and other stormwater quality improvement devices.</p> <p>This would involve routine and post-event observations of devices to establish if they require clean-out, and having appropriate capacity and resources within field teams to undertake device maintenance.</p> <p>Monitoring should include monthly inspections and recording of the level of material. Also inspections should be carried out on the day following a daily rainfall total greater than 25ml's to see if the device is blocked.</p> <p>A standard reporting should be developed for Council or its Contractors to use.</p>										
Links to existing works	HNCAP 2013 Sydney Landscape Management Target 1 : By 2023 implement Water Sensitive Urban Design to reduce catchment inputs and improve or maintain condition of waterways										
Commencement	2015										
Costs, Resources and Funding Opportunities	This action would be carried out by Council officers. Additional resources would be required. Allow \$100,000 for personnel and monitoring.										
Lead Responsibilities	Council										
Support Responsibilities	HRCC, GSLLS										
Performance Measures	Monitoring of maintenance and WQ first to establish baseline. Reduction in frequency of device being overloaded										

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WQ7	Utilise hydrodynamic and water quality model being developed by Sydney Water to understand potential sea level rise impacts on salinity profile										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Study Team					Short-listed Priority	High				
Focus Area / Approach Category	Design and Mapping					Applicable to	All study zones (Estuary wide)				
Detailed Description	<p>Sydney Water has developed a new Hawkesbury-Nepean River hydrodynamic and water quality modelling system. The new model was established to inform wastewater infrastructure investment decisions for Sydney's north-west and south-west growth sectors.</p> <p>The modelling system simulates the hydrology, hydraulics and biochemical processes to determine the water quality benefits and impacts resulting from various wastewater treatment environmental flow, water sensitive urban design and land-use change scenarios.</p> <p>Subject to permission being granted, the hydrodynamic and water quality model should be used to assess impacts of climate change / sea level rise, changes to water sharing plan arrangements and the potential impacts of proposed management scenarios identified relative to baseline conditions.</p> <p>Consideration should be given to impacts on stock watering and irrigation.</p>										
Links to existing works	BMT WBM, 2012 Hawkesbury Nepean Modeling Report										
Commencement	2015										
Costs, Resources and Funding Opportunities	Approximately \$50,000 depending on the scope of modelling required										
Lead Responsibilities	Council										
Support Responsibilities	Sydney Water, GSLLS, OEH										
Performance Measures	<ol style="list-style-type: none"> 1. Model made available for use by Council 2. Scenarios modelled and outcomes incorporated into adaptive management process for the river system. 										

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WQ8	Implement an environmental health monitoring program and issue biennial report cards										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Council					Short-listed Priority		High			
Focus Area / Approach Category	Parks and Recreation					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>As part of the implementation of this CZMP, undertake monitoring of a range of indicators to measure estuary health. Information from this monitoring program will be used as a baseline to track how well the estuary is being managed over time and whether implementation of the completed Coastal Zone Management Plan is contributing to improved estuary health. In addition, the River Health Monitoring Program report cards will be used to inform the community of the current health of the estuary.</p> <p>The monitoring program will need to be modified according to available resources and increasing understanding of processes. Initial parameters to be monitored should include</p> <ul style="list-style-type: none"> • Physio chemical water quality parameters at current locations (pH, DO, EC); • Aquatic macroinvertebrates; • Weeds; • Bank erosion; • Ecosystem processes; • Nutrient cycling; and • Length / area of riparian vegetation. <p>Additional information on targets, timing and approach are included in Section 4. In particular please refer to the guidance given in the Table 4-1 Monitoring Schedule.</p>										
Links to existing works	<p>Department of Environment and Climate Change (2009) Hawkesbury – Nepean River Environmental Monitoring Program</p> <p>Department of Environment and Climate Change Draft Lower Hawkesbury Nepean River nutrient management strategy</p>										
Commencement	2015										
Costs, Resources and Funding Opportunities	Allow an additional \$45,000 every two years for analyses and report card preparation										
Lead Responsibilities	Council										
Support Responsibilities	OEH, SCA										
Performance	1. Monitoring undertaken										

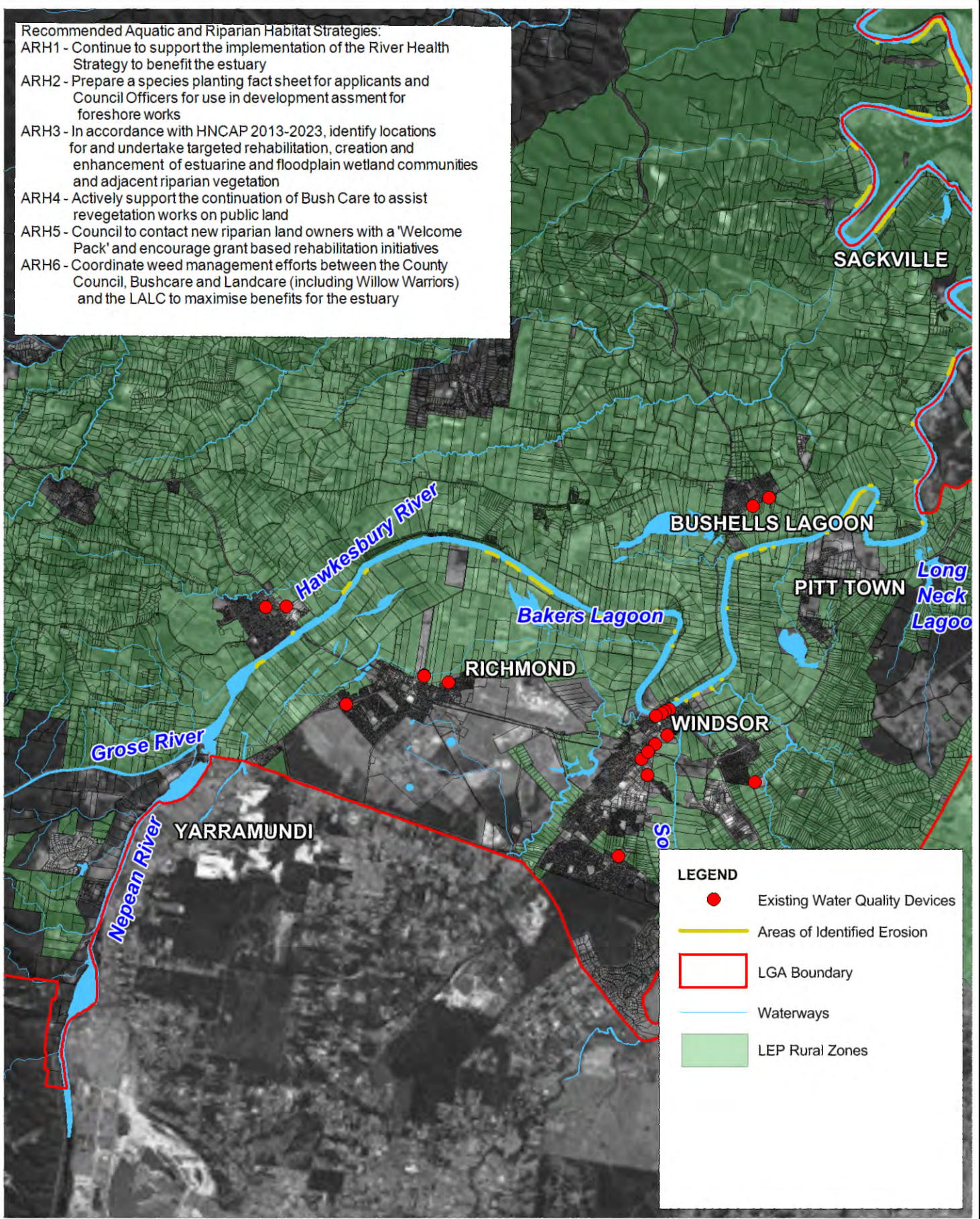
WQ8	Implement an environmental health monitoring program and issue biennial report cards
Measures	<ol style="list-style-type: none">2. Report cards prepared and distributed3. Monitoring results informing management

3.2 Aquatic and Riparian Habitat Sub-Plan

AQUATIC AND RIPARIAN HABITAT SUB-PLAN

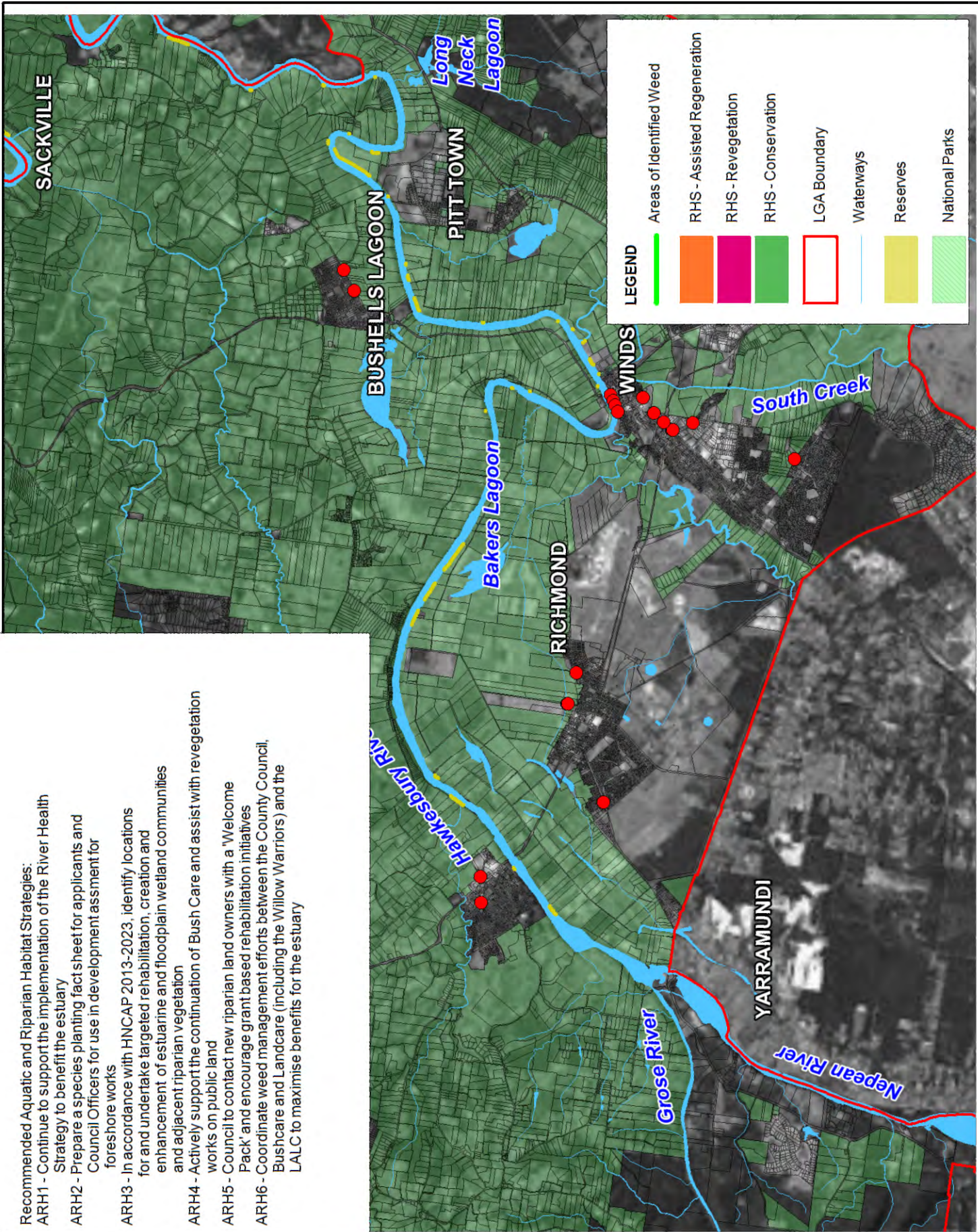
Recommended Aquatic and Riparian Habitat Strategies:

- ARH1 - Continue to support the implementation of the River Health Strategy to benefit the estuary
- ARH2 - Prepare a species planting fact sheet for applicants and Council Officers for use in development assessment for foreshore works
- ARH3 - In accordance with HNCAP 2013-2023, identify locations for and undertake targeted rehabilitation, creation and enhancement of estuarine and floodplain wetland communities and adjacent riparian vegetation
- ARH4 - Actively support the continuation of Bush Care to assist revegetation works on public land
- ARH5 - Council to contact new riparian land owners with a 'Welcome Pack' and encourage grant based rehabilitation initiatives
- ARH6 - Coordinate weed management efforts between the County Council, Bushcare and Landcare (including Willow Warriors) and the LALC to maximise benefits for the estuary



<p>Title:</p> <p>Aquatic and Riparian Habitat Sub-Plan: Upper Hawkesbury River (lower reaches)</p>	<p>Figure:</p> <p>3-3</p>	<p>Rev:</p> <p>C</p>
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<p>BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.</p>		
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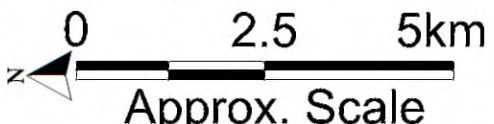
- Recommended Aquatic and Riparian Habitat Strategies:
- ARH1 - Continue to support the implementation of the River Health Strategy to benefit the estuary
 - ARH2 - Prepare a species planting fact sheet for applicants and Council Officers for use in development assessment for foreshore works
 - ARH3 - In accordance with HNCAP 2013-2023, identify locations for and undertake targeted rehabilitation, creation and enhancement of estuarine and floodplain wetland communities and adjacent riparian vegetation
 - ARH4 - Actively support the continuation of Bush Care and assist with revegetation works on public land
 - ARH5 - Council to contact new riparian land owners with a 'Welcome Pack' and encourage grant based rehabilitation initiatives
 - ARH6 - Coordinate weed management efforts between the County Council, Bushcare and Landcare (including the Willow Warriors) and the LALC to maximise benefits for the estuary

Title:
**Aquatic and Riparian Habitat Sub-Plan:
 Upper Hawkesbury River (upper reaches)**

Figure:
3-4

Rev.
C

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



ARH1	Continue to support the implementation of the River Health Strategy to benefit the estuary											
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K	
Suggested by	Community					Short-listed Priority		Very High				
Focus Area / Approach Category	Strategic Planning					Applicable to		All study zones (Estuary wide)				
Detailed Description	<p>The Hawkesbury Nepean River Health Strategy is a practical tool for managing and improving the health of the waterways in the catchment. The Strategy provides a comprehensive understanding of the values, threats and issues affecting 255 river reaches and 3,600 km of waterway. The Strategy helps to identify priorities for on-ground investment in river health to ensure environmental outcomes are maximised. The strategy is linked directly to the Catchment Action Plan, which outlines proposed catchment works and initiatives for the next 10 years.</p> <p>To help develop the Strategy, seven local expert panels were held across the catchment to carry out a rapid reach assessment for local waterways. Actions have been incorporated into the following programs:</p> <ul style="list-style-type: none"> • River Restoration Project; • Wetland Program; • Estuary Program; and • Saltmarsh Project. <p>The GSLLS will be using the River Health Strategy to assess applications for funding from councils and landholders in the catchment. The GSLLS also works closely with State Government agencies, Local Governments, landholders and community groups to carry out the actions identified in the strategy and to ensure this investment is protected and enhanced.</p> <p>Priority Reach Management recommendations consistent with the CZMP are:</p> <p>HNE R1 Webbs Creek Junction (just upstream of Wisemans Ferry) -</p> <ul style="list-style-type: none"> • Management of stock impacts on waterways • Encourage adoption of sustainable land management practices in riparian lands • Manage human impacts at public recreation river access points along foreshores • Riparian wetland management <p>HN R2 Upper Crescent Reach downstream to Webbs Creek Confluence</p> <ul style="list-style-type: none"> • Manage aquatic weeds • Riparian wetland management 											

ARH1	Continue to support the implementation of the River Health Strategy to benefit the estuary
	<ul style="list-style-type: none"> • Manage human impacts at river access points <p>HN R1 From Grose River confluence to start of Upper Crescent Reach</p> <ul style="list-style-type: none"> • Revegetation with indigenous riparian vegetation • Riparian wetland management • Management of stock impact on waterways • Encourage adoption of sustainable land management practices on riparian lands <p>A review of the River Health Strategy is included in the Synthesis Report prepared as an earlier stage to the CZMP project (refer to Section 1 of this report and BMT WBM 2013a). This CZMP supports the principles of the River Health Strategy.</p>
Links to existing works	GSLLS Website: http://www.hn.cma.nsw.gov.au/topics/2201.html
Commencement	2015
Costs, Resources and Funding Opportunities	Allow \$20,000 per year as Council contribution to implementation of the River Health Strategy. This is in addition to funds available through GSLLS.
Lead Responsibilities	Council
Support Responsibilities	GSLLS, HRCC
Performance Measures	1. River Health Strategy projects implemented through partnerships with Council and the NSW Government Estuary Management Grant program

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ARH2 Prepare a species planting fact sheet for applicants and Council officers for use in a development assessment of foreshore works											
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
	✓		✓						✓		
Suggested by	Study team and field inspection discussions					Short-listed Priority		Very High			
Focus Area / Approach Category	Parks and Recreation					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>The aim of this action is to encourage the planting of local native plant species from the relevant vegetation community to enhance bank stability, water quality, connectivity, green corridors, habitat and succession of desired adult trees within the river riparian zone.</p> <p>Appendix D of the Hawkesbury DCP should include recommendations for appropriate species for use on riparian land, and in stream or behind structures (noting that soft bank management strategies should always be a first option before structures).</p> <div data-bbox="483 954 1401 1415" data-label="Image"> </div> <p><i>An example of a past rehabilitation project that is now well established.</i></p> <p>The benefits of vegetation and appropriate species should be outlined to include bank stabilisation, water quality improvement and habitat provision. Introducing a native vegetation buffer directly behind the top of seawalls and within the gaps amongst rock seawalls creates habitat, shelter and a source of food, benefiting both terrestrial and aquatic species along the foreshore. Estuarine water quality could also be improved through filtration of pollutants in overland runoff before it enters the estuary.</p> <p>This action should also aim to address one of the key aims of Habitat Protection Plan Number 3 under the <i>Fisheries Management Act</i> 1994 of improving and restoring key aquatic habitats.</p>										
Links to existing works	<p>Grow Me Instead initiative by the Nursery and Garden Industry Association.</p> <p>Environmentally Friendly Seawalls: A guide to improving the Environmental Value of Seawalls and Seawall lined Foreshores in Estuaries (CMA 2009)</p> <p>HNCAP 2013 Strategy B4 Reduce the risk of a decline of native species</p> <p>Habitat Protection Plan Number 3 Hawkesbury Nepean River System (under the <i>Fisheries Management Act</i> 1994)</p>										

ARH2	Prepare a species planting fact sheet for applicants and Council officers for use in a development assessment of foreshore works
	<p>Buffer Zones along Rivers and Creeks. Riverwise - Advisory Notes for Rural Landholders from the Department of Land and Water Conservation. DLWC (1998).</p> <p>Riverbank planting guide: Penrith floodplain (Information Sheet No 3). Hawkesbury Nepean Catchment Management Trust and DLWC (1999)</p> <p>Riverbank planting guide: Richmond-Windsor floodplain (Information Sheet No 4) Hawkesbury Nepean Catchment Management Trust and DLWC (1999)</p> <p>Riverbank planting guide: Lower Hawkesbury Estuary (Information Sheet No 10) Hawkesbury Nepean Catchment Management Trust and DLWC (1999)</p>
Commencement	2015
Costs, Resources and Funding Opportunities	Allow \$5,000
Lead Responsibilities	At present, community nursery staff advise private land owners about the most suitable species for their property locations. Council would be responsible for preparing a species planting guide based on current knowledge and advice provided by the community nursery with assistance from the HRCC and GSLLS as required.
Support Responsibilities	HRCC, GSLLS, Willow Warriors
Performance Measures	<ol style="list-style-type: none"> 1. Species planting guideline prepared 2. Species planting recommendations included in DA approvals

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ARH3	In accordance with the HNCAP 2013-2023, identify locations for and undertake targeted rehabilitation, creation and enhancement of estuarine and floodplain wetland communities and adjacent riparian vegetation										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	River Health Strategy					Short-listed Priority		High			
Focus Area / Approach Category	Parks and Recreation					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>The Upper Hawkesbury River Estuary and its catchment is included in the Sydney Landscape and Central Landscape Management Units from HNCAP.</p> <p>Sydney Landscape Management Target 1: By 2023 implement Water Sensitive Urban Design to reduce catchment inputs and improve or maintain condition of waterways</p> <p>Sydney Landscape Management Target 2: By 2023, improve habitat condition and connectivity of the foreshore, estuary, marine and in-stream habitat.</p> <p>Sydney Landscape Management Target 4: By 2023, increase the awareness of water users and land managers of the impacts of human use on water quality and aquatic habitat.</p> <p>Where actions within the present plan contribute to these principles, opportunities to partner with GSLLS should be taken.</p>										
Links to existing works	<p>http://www.hn.cma.nsw.gov.au/multiattachments/6818.html</p> <p>Preparation of this CZMP is an action under the HNCAP 2013 (Action UL4) Riverbank Protection Project Information Sheets available from GSLLS</p>										
Commencement	2015										
Costs, Resources and Funding Opportunities	Allow \$100,000 for year one.										
Lead Responsibilities	Actions to be investigated and implemented by Council where appropriate.										
Support Responsibilities	HRCC, GSLLS, OEH										
Performance Measures	<ol style="list-style-type: none"> 1. List of actions within this CZMP that contribute to meeting HNCAP Management Targets 2. Implementation of these actions 										

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ARH4	Actively support the continuation of Bush Care to assist with revegetation works on public land										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Study Team					Short-listed Priority		High			
Focus Area / Approach Category	Parks and Recreation					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>Bush Care is an environmentally focused volunteer program primarily occurring on publically owned land in partnership with government organisations throughout NSW. Council funding for Bush Care facilitates bush regeneration by providing volunteers with training, tools, supervision and technical advice.</p> <p>This action would involve continuing Council's support of this program. It is also important that the work undertaken through this program is consistent with the intent of the CZMP. For example, volunteers should be aware of the possibility of uncovering Aboriginal items and have an understanding of what to do in this circumstance. Priority should be given to rehabilitation of vulnerable estuarine communities, particularly where migration in response to sea level rise is a possibility. Recognition of volunteer activities through initiatives such as the annual Bush Care Awards hosted by HCC should continue.</p>										
Links to existing works	http://www.hawkesbury.nsw.gov.au/environment/natural-environment/bushcare										
Commencement	Ongoing										
Costs, Resources and Funding Opportunities	<p>Allow \$20,000 per year.</p> <p>Many funding opportunities through government grants such as Caring for Country, Biodiversity Fund etc</p>										
Lead Responsibilities	Council to continue supporting Bush Care projects across the LGA.										
Support Responsibilities	HRCC, GSLLS										
Performance Measures	1. Completed rehabilitation projects under the Bush Care program.										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

ARH5	Council to contact new riparian land owners with a 'Welcome Pack' and encourage grant based rehabilitation initiatives										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Study Team Field inspection and discussions					Short-listed Priority		Moderate			
Focus Area / Approach Category	Parks and Recreation					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>This would be a Council led program to identify when privately owned riparian land changes ownership and to contact new owners making them aware of opportunities for grants to improve the condition of riparian lands. Council would contact new owners with a 'Welcome Pack' to encourage their involvement in rehabilitation works.</p> <p>Implementation of this action would be on an opportunistic basis depending on prevailing real estate market conditions and turnover. At the time of writing, at least eight substantial parcels of river side land within the study area are listed for sale.</p> <p>All existing landowners should be contacted to determine if there is any interest in undertaking riparian rehabilitation projects.</p> <p>Riparian vegetation rehabilitation, cattle exclusion fences and environmentally sensitive bank protection would be the focus. A primary aim of these works would be to protect and enhance fish habitat.</p> <p>Opportunities to incorporate the use of artificial wetlands to improve the quality of agricultural runoff will be encouraged.</p>										
Links to existing works	<p>Hawkesbury Nepean Catchment Action Plan 2013 Strategy UL1 <i>Empower communities to understand and value ecosystem services and actively manage natural resources</i></p> <p>Habitat Protection Plan Number 3 Hawkesbury Nepean Catchment (Under the Fisheries Management Act 1994)</p>										
Commencement	2015										
Costs, Resources and Funding Opportunities	<p>Identifying and contacting new land holders would be a minimal cost to be absorbed by Council. Funding opportunities through GSLLS.</p> <p>Support HRCC in their bid to secure extra funding from Government.</p>										
Lead Responsibilities	Council										
Support Responsibilities	Land and Property Information for assistance with the notice of sale. GSLLS has existing fact sheets available.										
Performance Measures	<ol style="list-style-type: none"> 1. New owners contacted 2. Privately owned riparian lands rehabilitated 										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

ARH6	Coordinate weed management efforts between the County Council, Bushcare and Landcare (including Willow Warriors) and the LALC to maximise benefits for the estuary											
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K	
Suggested by	Community					Short-listed Priority		Moderate				
Focus Area / Approach Category	Parks and Recreation					Applicable to		All study zones (Estuary wide)				
Detailed Description	<p>This action will require coordination of weed management efforts between the County Council, Bush Care, Land Care (including Willow Warriors) and the LALC to maximise benefits for the Estuary by clearing existing weeds and minimising the establishment of new weed growth by strategic native riparian vegetation plantings.</p> <p>A key resource to underpin this will be centrally available mapping, and database showing focus areas and hotspots so that the different organisations can cooperate. The data base should include timing, dates and methods for weed management activities and include follow on monitoring.</p> <p>It is suggested that a regional Hawkesbury Weed Steering Committee meet quarterly with representation from each of the groups.</p> <p>A pilot project based on the emerging weed <i>Arundo donax</i> could be used in the early stages of implementing this action. The Arundo mapping reported in BMT WBM (2013b) is considered to be a starting point.</p> <p>A regional committee, The Sydney Weeds Committee, which includes the Sydney West and Blue Mountains currently operates. The Committee meets regularly to improve weed management and includes Government and Non-Government representatives.</p>											
Links to existing works	<p><u>Hawkesbury City Council:</u> http://www.hawkesbury.nsw.gov.au/environment/natural-environment#weeds</p> <p><u>Hawkesbury River County Council:</u> http://hrcc.nsw.gov.au/</p> <p><u>Willow Warriors:</u> http://willowwarriors.org.au/projects</p> <p><u>Hawkesbury Bushcare:</u> http://www.hawkesbury.nsw.gov.au/environment/natural-environment/bushcare</p> <p><u>Land Care:</u> http://www.hn.cma.nsw.gov.au/topics/2126.html</p> <p>Arundo mapping (BMT WBM, 2013b) http://sydneyweeds.org.au</p>											
Commencement	2015											
Costs, Resources and Funding Opportunities	Additional funding is required to expand the current program. Allow \$50,000											
Lead	Council and the HRCC to coordinate management efforts. HRCC is responsible for											

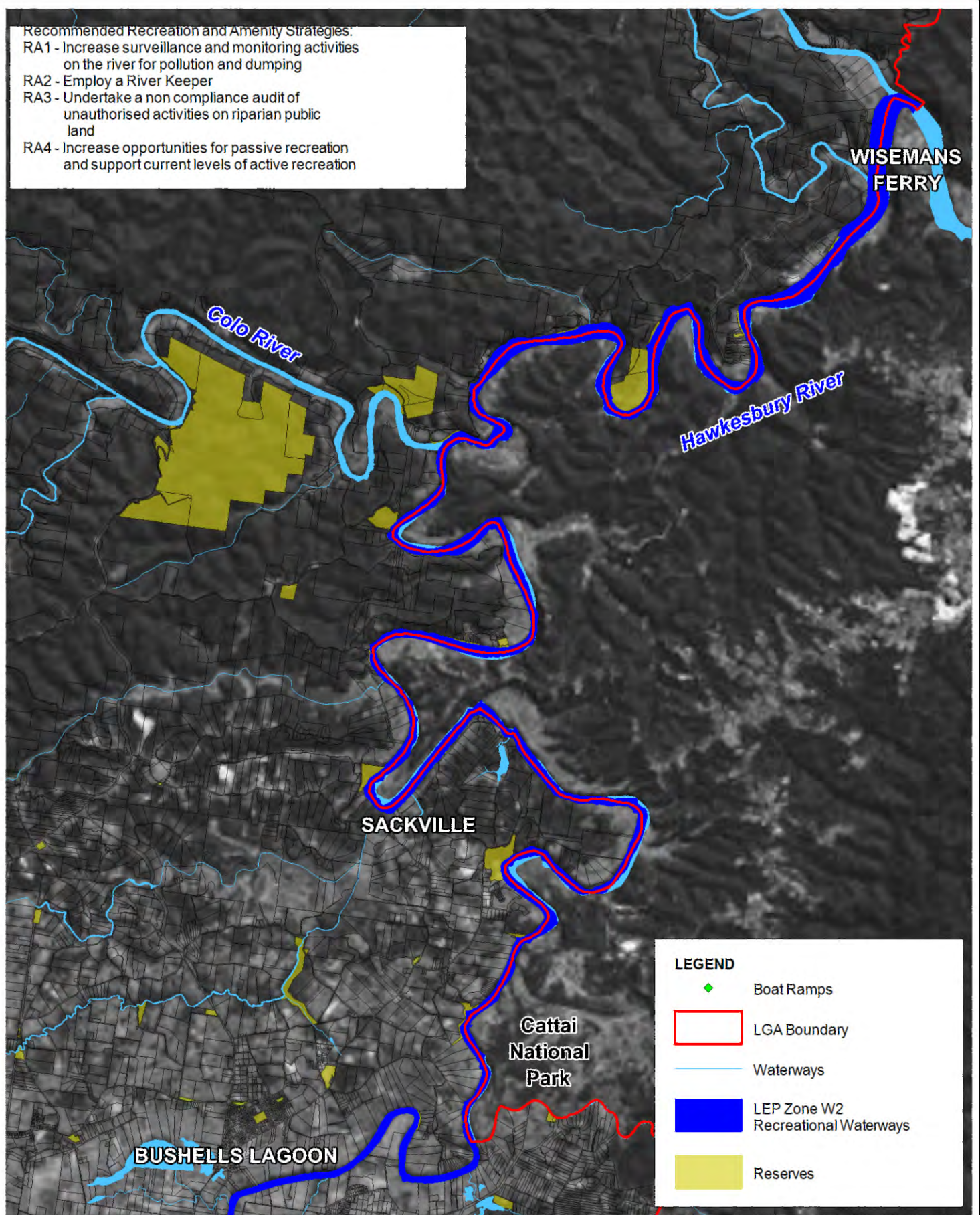
ARH6	Coordinate weed management efforts between the County Council, Bushcare and Landcare (including Willow Warriors) and the LALC to maximise benefits for the estuary
Responsibilities	the management of noxious weeds in the Hawkesbury LGA.
Support Responsibilities	Assistance from the LALC and volunteer groups including Hawkesbury Bush Care, Land Care and Willow Warriors. NPWS, Crown Land, RMS
Performance Measures	<ol style="list-style-type: none"> 1. Coordinated weed management actions in place 2. All groups using and contributing to mapping and database 3. Quarterly meetings by Hawkesbury Weed Steering Committee

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

3.3 Recreation and Amenity Sub-Plan

RECREATION AND AMENITY SUB-PLAN

Recommended Recreation and Amenity Strategies:
 RA1 - Increase surveillance and monitoring activities on the river for pollution and dumping
 RA2 - Employ a River Keeper
 RA3 - Undertake a non compliance audit of unauthorised activities on riparian public land
 RA4 - Increase opportunities for passive recreation and support current levels of active recreation



LEGEND

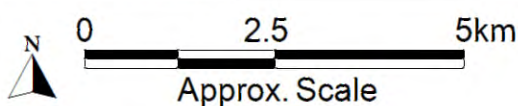
- ◆ Boat Ramps
- LGA Boundary
- Waterways
- LEP Zone W2 Recreational Waterways
- Reserves

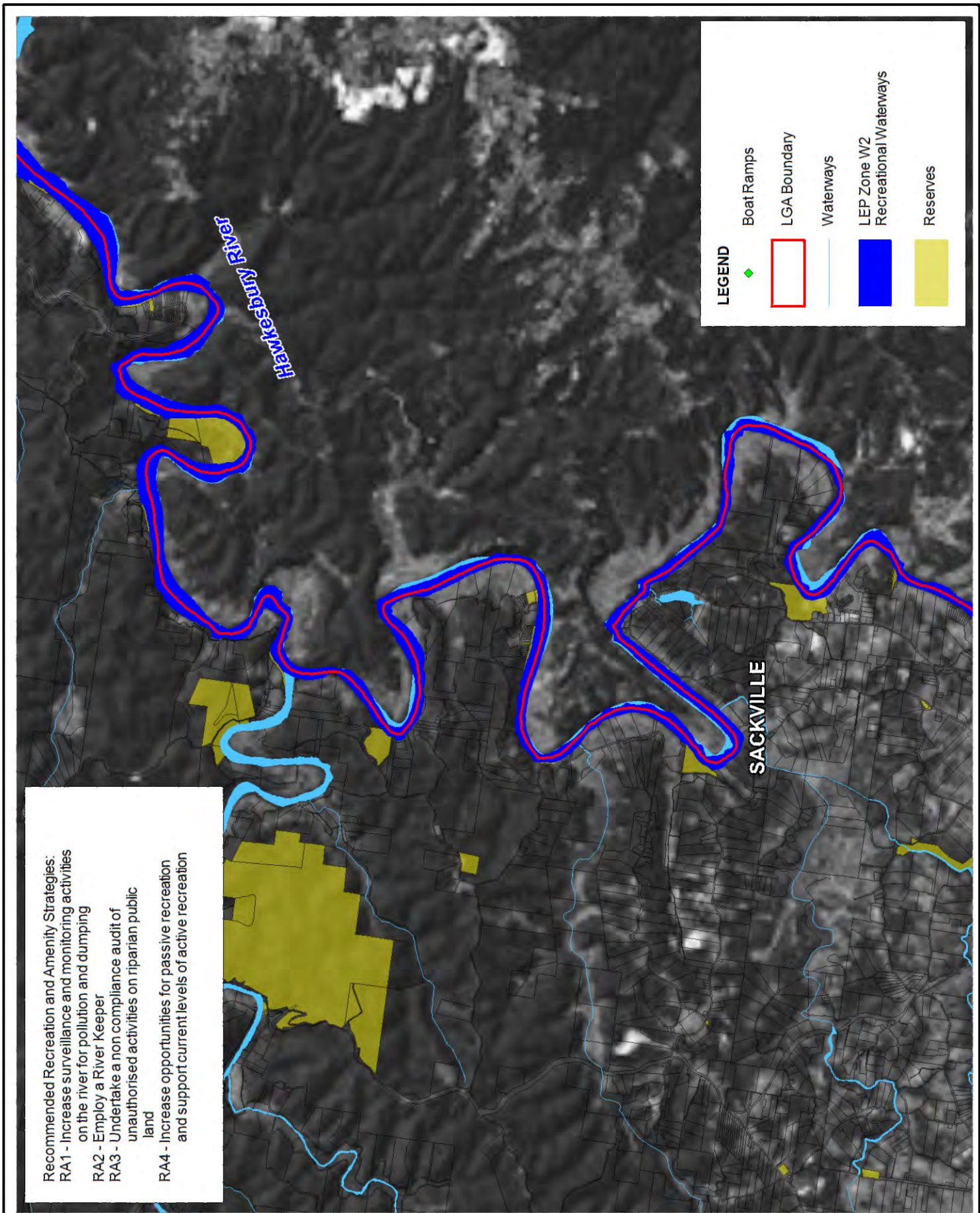
Title:
**Recreation and Amenity Sub-Plan:
 Upper Hawkesbury River (lower reaches)**

Figure:
3-5

Rev:
C

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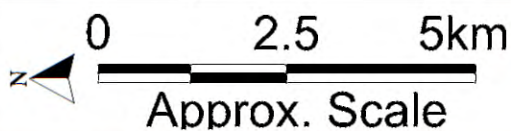


Title:
**Recreation and Amenity Sub-Plan:
 Upper Hawkesbury River (upper reaches)**

Figure:
3-6

Rev:
C

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RA1	Increase surveillance and monitoring activities on the river for pollution and dumping										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Community					Short-listed Priority		High			
Focus Area / Approach Category	Regulatory and Environmental Services					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>Dumping of waste and construction materials is an issue, particularly downstream of Windsor. In some instances, ad hoc foreshore protection works have broken up and littered the river.</p> <p>The <i>Protection of the Environment Operations Act 1997</i> (POEO Act) is the main piece of NSW environmental legislation covering water, land, air and noise pollution and waste management. HCC has the authority to regulate this Act through notices and prosecutions. The POEO Act gives Council the power to enter and inspect premises and issue clean-up or prevention notices and on-the-spot fines. They can also regulate using development consents.</p> <p>Pollution Monitoring Data is collected from Council's wastewater and waste management facilities as required under the Environment Protection Licences issued by the NSW Environment Protection Authority (EPA).</p> <p>This action involves an intensive program of inspections and compliance activity coupled with media releases to deter polluters from dumping waste and to prevent future dumping.</p>										
Links to existing works	<p>Council website: http://www.hawkesbury.nsw.gov.au/environment/environment-monitoring</p>										
Commencement	2015-2016										
Costs, Resources and Funding Opportunities	Council does not currently undertake compliance for pollution and dumping. This action would likely include part of the time of additional staff. Allow \$60,000 per annum										
Lead Responsibilities	Council, DPI, EPA, RMS										
Support Responsibilities	Support can be provided by HRCC and environmental groups in identifying sources of pollution and dumping grounds, which can be targeted by Council Officers, Bush Care, HRCC, Land Care, Willow Warriors.										
Performance Measures	<ol style="list-style-type: none"> 1. Number of compliance inspections made 2. Number of compliance notices issued 3. Time spent monitoring river activities 										

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RA2 Employ a River Keeper											
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
	✓				✓			✓			
Suggested by	Lower Hawkesbury Estuary Management Plan					Short-listed Priority		High			
Focus Area / Approach Category	Parks and Recreation					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>In other estuaries in the Sydney area, such as Port Hacking and the Georges River, Council and the NSW Maritime Authority cooperate to implement a 'River Keeper Program'. The program provides resources for enforcement of regulations, development of policy and coordination of programs to rehabilitate the waterways and foreshores, and to enhance the natural, commercial and recreational values. Regular presence on the waterway acts as a deterrent for inappropriate activities and increases educational awareness. The River Keeper also provides a monitoring role.</p> <p>Specific tasks that would be helpful to include in the position description for a River Keeper for the Upper Hawkesbury Estuary are:</p> <p>Compliance – in regards to water based development, riparian vegetation clearing, dumping and boating regulations</p> <p>Education – waste management, weeds, riparian rehabilitation and pollution</p> <p>Monitoring – success of rehabilitation and weed eradication, water based development, stock access, bank erosion, native vegetation and GPT condition</p>										
Links to existing works	MOU Port Hacking Riverkeeper Program										
Commencement	2016										
Costs, Resources and Funding Opportunities	Allow \$150,000 per year for position and associated resources, including a boat In-kind contributions including discussion and advice, relevant case studies from the RMS, HRCC and neighbouring Councils										
Lead Responsibilities	Council to employ River Keeper										
Support Responsibilities	RMS, HRCC, HSC										
Performance Measures	<ol style="list-style-type: none"> 1. MoU prepared and signed 2. Riverkeeper position clearly defined 3. Riverkeeper employed and engaged in duties 										

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RA3	Undertake a noncompliance audit of unauthorised activities and use of riparian public land										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Study Team Field Inspections and discussions					Short-listed Priority		High			
Focus Area / Approach Category	Regulatory and Environmental Services					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>The first step in implementing this option would be to undertake an audit and mapping of unauthorised encroachment onto public land. Land ownership should be clearly mapped.</p> <p>Compliance activities should then be targeted at private development on public land with rehabilitation requirements consistent with this CZMP and the broader objectives of HNCAP 2013.</p>										
Links to existing works											
Commencement	2016										
Costs, Resources and Funding Opportunities	<p>This action may require the employment of additional mapping and compliance staff. Previously this responsibility may have rested in part with the Office of Hawkesbury Nepean. Allow \$100,000 in the first year.</p> <p>Mapping activities could be undertaken in-house by Council.</p>										
Lead Responsibilities	Council										
Support Responsibilities	Crown Lands, DPI, RMS, there may be a roll for the River Keeper in assisting with this option (if adopted)										
Performance Measures	<ol style="list-style-type: none"> 1. Unauthorised use and development on public land mapped 2. Offenders notified and instructed to remove encroachments and rehabilitate lands affected 3. Repeat mapping exercise in 2 years shows a reduction in unauthorised use and development of public land 										

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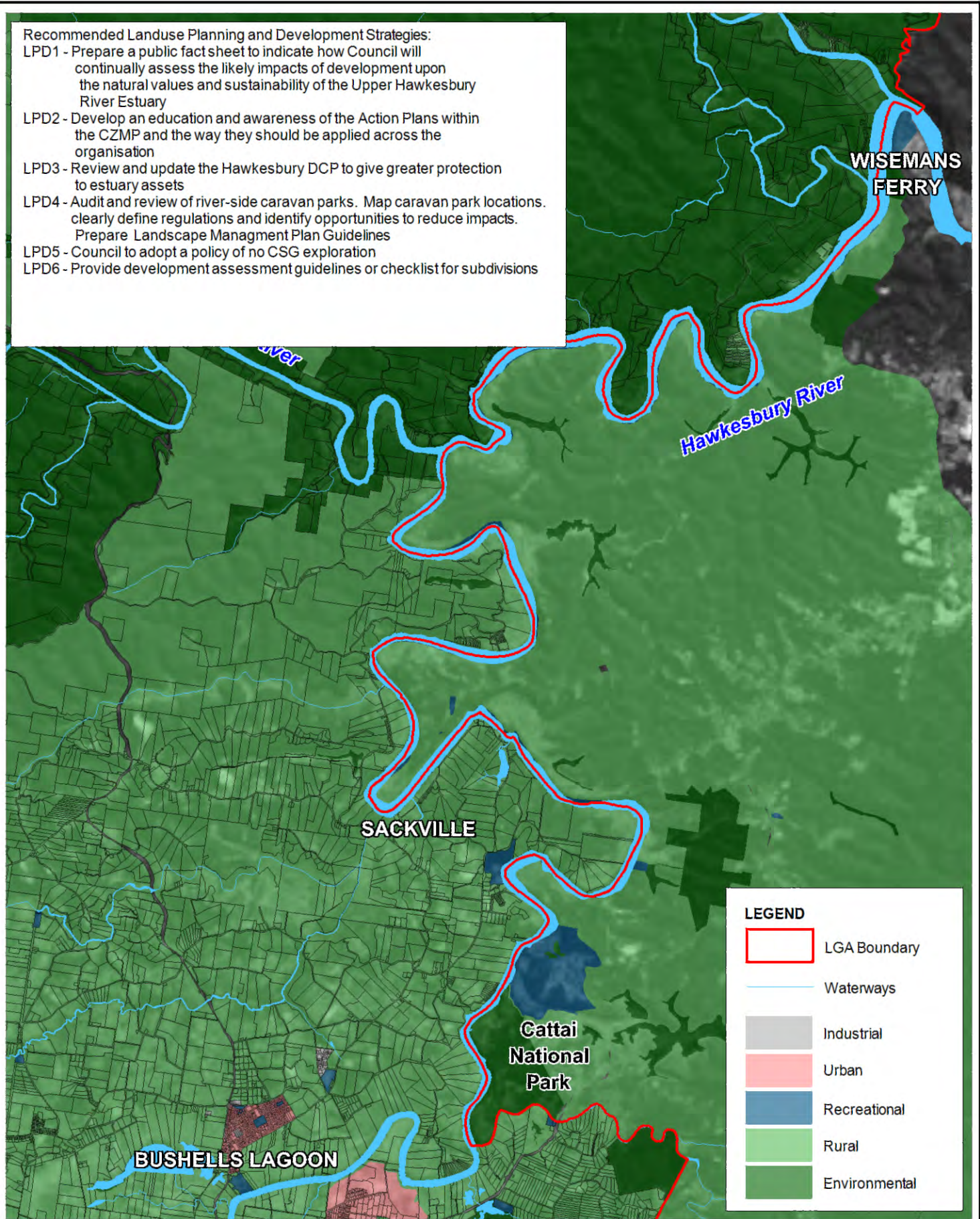
RA4	Increase opportunities for passive recreation and support current levels of active recreation										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by						Short-listed Priority	Moderate				
Focus Area / Approach Category	Parks and Recreation					Applicable to	All study zones (Estuary wide)				
Detailed Description	Any changes to recreational amenity should consider the carrying capacity of the estuary. The first step is to undertake a recreational needs assessment which assesses appropriate levels of access by specific user groups. Existing boat launching facilities should be maintained and upgraded. Additional boat launching facilities should only be considered in the context of the recreational needs assessment. Where appropriate passive recreational opportunities may be increased through purchasing of land.										
Links to existing works	Windsor Foreshore POM										
Commencement	2015										
Costs, Resources and Funding Opportunities	Highly variable depending on opportunities sought										
Lead Responsibilities	Council										
Support Responsibilities	Crown Lands, DPI, RMS, there may be a roll for the River Keeper in assisting with this option (if adopted)										
Performance Measures	1.										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

3.4 Land Use Planning and Development Sub-Plan

LANDUSE PLANNING AND DEVELOPMENT SUB-PLAN

- Recommended Landuse Planning and Development Strategies:
- LPD1 - Prepare a public fact sheet to indicate how Council will continually assess the likely impacts of development upon the natural values and sustainability of the Upper Hawkesbury River Estuary
 - LPD2 - Develop an education and awareness of the Action Plans within the CZMP and the way they should be applied across the organisation
 - LPD3 - Review and update the Hawkesbury DCP to give greater protection to estuary assets
 - LPD4 - Audit and review of river-side caravan parks. Map caravan park locations, clearly define regulations and identify opportunities to reduce impacts. Prepare Landscape Management Plan Guidelines
 - LPD5 - Council to adopt a policy of no CSG exploration
 - LPD6 - Provide development assessment guidelines or checklist for subdivisions

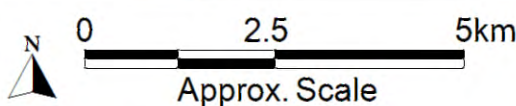


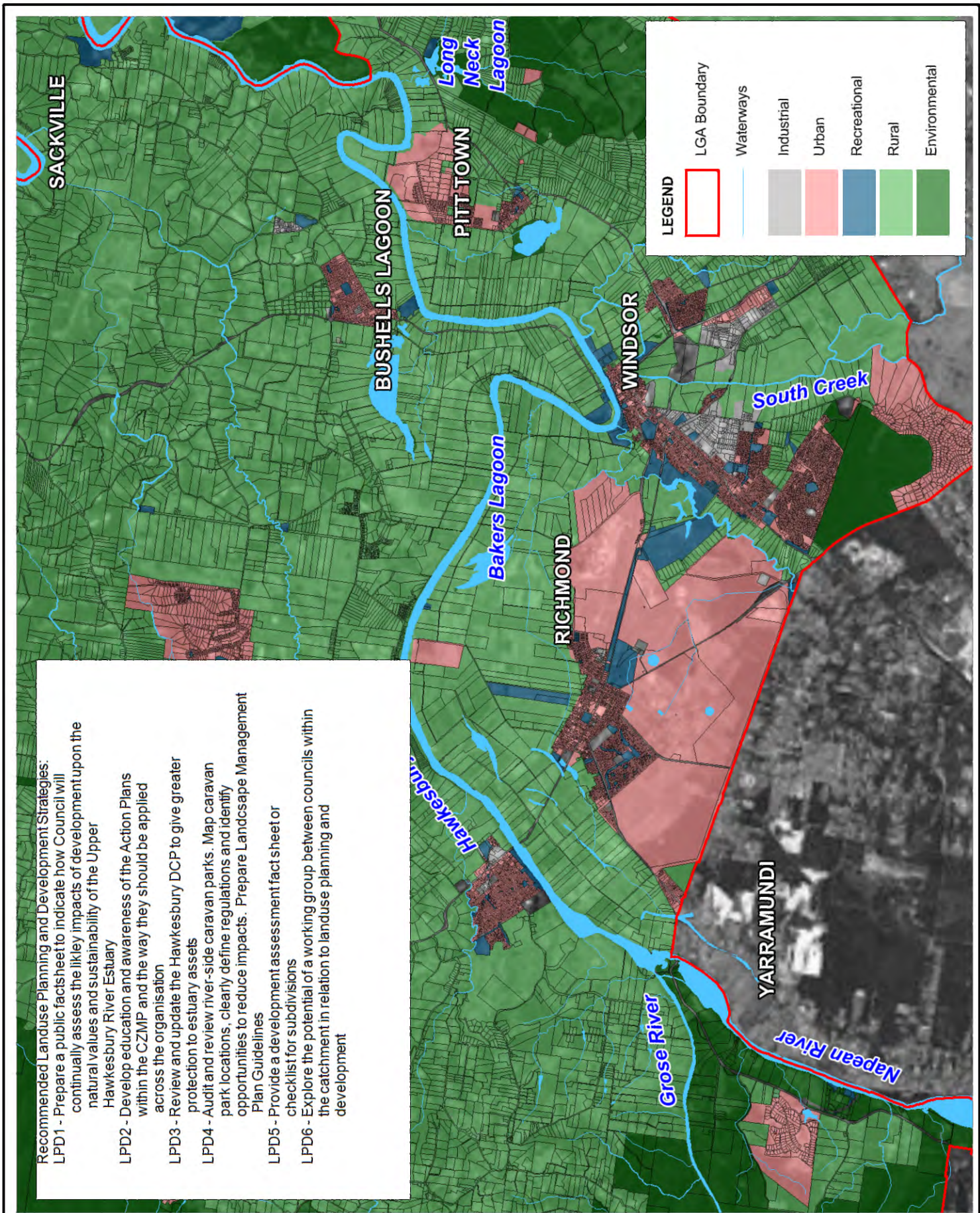
Title:
**Landuse Planning and Development Sub-Plan:
 Upper Hawkesbury River (lower reaches)**

Figure:
3-7

Rev:
B

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Recommended Landuse Planning and Development Strategies:
 LPD1 - Prepare a public factsheet to indicate how Council will continually assess the likely impacts of development upon the natural values and sustainability of the Upper Hawkesbury River Estuary
 LPD2 - Develop education and awareness of the Action Plans within the CZMP and the way they should be applied across the organisation
 LPD3 - Review and update the Hawkesbury DCP to give greater protection to estuary assets
 LPD4 - Audit and review river-side caravan parks. Map caravan park locations, clearly define regulations and identify opportunities to reduce impacts. Prepare Landscape Management Plan Guidelines
 LPD5 - Provide a development assessment fact sheet or checklist for subdivisions
 LPD6 - Explore the potential of a working group between councils within the catchment in relation to landuse planning and development

Title: Landuse Planning and Development Sub-Plan: Upper Hawkesbury River (upper reaches)		Figure: 3-8	Rev: D
BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.			
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LPD1	Prepare a public fact sheet to indicate how Council will continually assess the likely impacts of development upon the natural values and sustainability of the Upper Hawkesbury River Estuary																		
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K								
	✓		✓																
Suggested by	Stakeholder workshop					Short-listed Priority		Very High											
Focus Area / Approach Category	Development Services					Applicable to		All study zones (Estuary wide)											
Detailed Description	<p>Develop a checklist for Council Development Assessment planners to assess the potential impacts of different types of DA's on the natural values and sustainability of the Upper Hawkesbury River Estuary.</p> <p>The tool should be designed to assist Council planning staff assess the likely impacts of future proposals on the natural processes and existing values of the Estuary. The implementation should include integration of the checklist into Council's planning framework.</p> <p>An example of how this might be set out is shown below (modified from WBM 2006):</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Criteria</th> <th style="width: 25%;">Examples</th> <th style="width: 25%;">Impact</th> <th style="width: 25%;">Assessment</th> </tr> </thead> <tbody> <tr> <td>Does the proposal involve a change in land use, or a significant change in development footprint (including land-based and water based development)</td> <td> <p>Low Density housing to medium or high density housing</p> <p>Subdivision of rural land to single or multiple lots</p> </td> <td>If yes then the proposal may increase the overall pollutant loads to the estuary including Total Nitrogen, Total Phosphorus, sediments, metals etc.</td> <td>The proposal should provide information on predicted pollutant generation (including surface runoff) and present mitigating measures, such as WSUD, buffer strips etc., to ensure that there is no net increase in pollutant loads to the receiving waters</td> </tr> </tbody> </table> <p>The checklist should be developed to cover waterway encroachment, pollutant inputs, biological impacts, and barriers on implementation of the CZMP.</p>											Criteria	Examples	Impact	Assessment	Does the proposal involve a change in land use, or a significant change in development footprint (including land-based and water based development)	<p>Low Density housing to medium or high density housing</p> <p>Subdivision of rural land to single or multiple lots</p>	If yes then the proposal may increase the overall pollutant loads to the estuary including Total Nitrogen, Total Phosphorus, sediments, metals etc.	The proposal should provide information on predicted pollutant generation (including surface runoff) and present mitigating measures, such as WSUD, buffer strips etc., to ensure that there is no net increase in pollutant loads to the receiving waters
Criteria	Examples	Impact	Assessment																
Does the proposal involve a change in land use, or a significant change in development footprint (including land-based and water based development)	<p>Low Density housing to medium or high density housing</p> <p>Subdivision of rural land to single or multiple lots</p>	If yes then the proposal may increase the overall pollutant loads to the estuary including Total Nitrogen, Total Phosphorus, sediments, metals etc.	The proposal should provide information on predicted pollutant generation (including surface runoff) and present mitigating measures, such as WSUD, buffer strips etc., to ensure that there is no net increase in pollutant loads to the receiving waters																
Links to existing works	http://www.hornsby.nsw.gov.au/media/documents/environment-and-waste/water-catchments/estuary-management/reports/brooklyn/Brooklyn-Estuary-Management-Plan-2006.pdf																		
Commencement	2015																		
Costs, Resources and Funding Opportunities	This is a low cost option that could be developed by Council staff. Requires Council staffing and budget.																		
Lead	Council																		

LPD1	Prepare a public fact sheet to indicate how Council will continually assess the likely impacts of development upon the natural values and sustainability of the Upper Hawkesbury River Estuary
Responsibilities	
Support Responsibilities	DoPI
Performance Measures	<ol style="list-style-type: none"> 1. Checklist complete and available on the Council website 2. Customers providing information as per fact sheet 3. Checklist being used for development assessment 4. Proposals modified for better estuary outcomes based on checklist

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LPD2	Develop education and awareness of the Action Plans within the CZMP and the way they should be applied across the organisation										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Study Team					Short-listed Priority		Very High			
Focus Area / Approach Category	Strategic Planning All					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>This may be best achieved by preparing an internal guideline or policy document to facilitate the consideration of estuary health in the preparation or revision of strategic documents, DCPs and works not requiring development consent.</p> <p>At the time of writing, NSW was embarking upon major planning reforms. A key focus of the reforms is to promote up-front strategic planning, to enable more complying and code-assessable development and greater efficiency in the assessment of development applications. It is unclear how this may impact upon estuary management, however, every opportunity to achieve good management outcomes should be taken.</p>										
Links to existing works	The NSW government proposed Planning Bill 2013										
Commencement	2015										
Costs, Resources and Funding Opportunities	<p>This needs to be integrated into Councils' existing operations.</p> <p>DPI Office of Water Controlled Activities on Waterfront Land Guidelines for Riparian Corridors on Waterfront Land https://www.google.com.au/?gfe_rd=cr&ei=0z30U8-gBujC8gfZ-4DgBA&gws_rd=ssl#q=DPI+Office+of+Water+Controlled+activities+on+waterfront+land+Guidelines+for+riparian+corridors+on+waterfront+land</p>										
Lead Responsibilities	Council										
Support Responsibilities	DoPI, DPI										
Performance Measures	1. Future strategic planning initiatives consistent with CZMP										

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LPD3	Review and update Hawkesbury DCP to give greater protection to estuary assets											
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K	
Suggested by	Synthesis Study					Short-listed Priority		Very High				
Focus Area / Approach Category	Strategic Planning					Applicable to		All study zones (Estuary wide)				
Detailed Description	A review of the Hawkesbury DCP should be undertaken to identify all opportunities to better protect the estuary assets. Specific requirements are also to be included in the DCP for the key focus areas of Water Sensitive Urban Design, Foreshore Protection and Rural Lands.											
Links to existing works												
Commencement	2015											
Costs, Resources and Funding Opportunities	Pending finalisation of CZMP liaise with The Hills Shire Council and Hornsby Shire Council											
Lead Responsibilities	Council											
Support Responsibilities	OEH, DPI											
Performance Measures	<ol style="list-style-type: none"> 1. DCP review undertaken 2. New DCP adopted 											

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LPD4	Audit and review of river-side caravan parks. Map caravan park locations, clearly define regulations and identify opportunities to reduce impacts. Prepare Landscape Management Plan Guidelines.										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
		✓						✓	✓		
Suggested by	Synthesis Study					Short-listed Priority		Very High			
Focus Area / Approach Category	Regulatory and Environmental Services					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>A Landscape Management Plan should be prepared that aims to improve the scenic, social and environmental amenity at the caravan parks located along the Upper Hawkesbury River.</p> <p>New Operators</p> <p>Within the Hawkesbury LGA, caravan park operators are required to apply for an Approval to Operate. The approvals are issued with Conditions to Operate. As part of that process it is recommended that they be required to develop a Landscape Management Plan for the site. Guidelines on how to prepare a Landscape Management Plan will need to be developed by Council in the form of a Factsheet or Information Pack.</p> <p>Existing Operators</p> <p>1 An audit and review of existing riverside caravan parks should be undertaken. This would involve mapping caravan park locations, clearly define regulations and identify opportunities to reduce impacts / reduce further proliferation.</p> <p>A key resource for implementing this action will be the checklist outlined in action LPD1. Particular aspects to focus on include:</p> <ul style="list-style-type: none"> • Number and appropriateness of foreshore structures (include access stairs, and bank protection works) • Impacts to scenic values • Pollution impacts, including wastewater management • Requirements for riparian vegetation rehabilitation works <p>2 Provide education and resources for existing owners through a forum to discuss issues and provision of information packages.</p> <p>This action would greatly benefit from a coordinated approach with The Hills Shire Council. Ideally this may be supported by a working group meeting on a periodic basis.</p> <p>3 Explore opportunities to invite the caravan park owners to prepare a Landscape Management Plan as part of any Development Applications to install structures on the site.</p>										
Links to existing works	It is understood that The Hills Council map structures annually.										

LPD4	Audit and review of river-side caravan parks. Map caravan park locations, clearly define regulations and identify opportunities to reduce impacts. Prepare Landscape Management Plan Guidelines.
Commencement	2015
Costs, Resources and Funding Opportunities	Allow \$30,000 for the preparation of the strategy and \$10,000 for the forum and educational material
Lead Responsibilities	Council to prepare guidelines for landscape management strategy
Support Responsibilities	Crown Lands, NPWS, The Hills Shire Council
Performance Measures	<ol style="list-style-type: none"> 1. Landscape strategy prepared 2. Landscape strategy implemented

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LPD5	Provide development assessment fact sheet or checklist for subdivisions										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Stakeholder Workshop					Short-listed Priority	Moderate				
Focus Area / Approach Category	Development Services					Applicable to	All study zones (Estuary wide)				
Detailed Description	<p>In addition to the general fact sheet described in LPD1, provide detailed development assessment checklist for the subdivision of rural land within the catchment. Particular focus should be placed on river side lands.</p> <p>The proposed layout for development needs to include an appropriate riparian buffer consistent with the DPI Office of Water Controlled activities on waterfront land Guidelines for riparian corridors on waterfront land</p> <p>This will generally mean a 40m wide vegetated riparian zone.</p> <p>A key goal of the guidelines will be to maximise riparian corridors and reduce fragmented private frontages.</p> <p>This option would greatly benefit from a cooperative approach between HSC and HCC.</p>										
Links to existing works	<p>Department of Primary Industries Office of Water Controlled activities on waterfront land - Guidelines for riparian corridors on waterfront land.</p> <p>https://www.google.com.au/?gfe_rd=cr&ei=0z30U8-gBujC8gfZ-4DqBA&gws_rd=ssl#q=DPI+Office+of+Water+Controlled+activities+on+waterfront+land+Guidelines+for+riparian+corridors+on+waterfront+land</p>										
Commencement	2015										
Costs, Resources and Funding Opportunities	Development assessment guidelines could be completed in-house as a coordinated effort between staff in Strategic Planning, Development Services and Infrastructure Services. Requires Council staffing and budget.										
Lead Responsibilities	Council										
Support Responsibilities											
Performance Measures	<ol style="list-style-type: none"> 1. Guidelines written 2. Guidelines implemented 										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

LPD6	Explore potential of a working group between Councils within the catchment in relation to land use planning and development											
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K	
Suggested by	Study Team						Short-listed Priority	High				
Focus Area / Approach Category	Strategic Planning						Applicable to	All study zones (Estuary wide)				
Detailed Description	<p>There are a range of landuse planning and development aspects that would benefit from a consistent approach across local government areas. Some of the issues identified through the CZMP process include compliance, water based development assessments, regulations regarding caravan parks and water sensitive urban design.</p> <p>Development of the working group should be considered by the Upper Hawkesbury Estuary Management Committee (described in Action ME4).</p>											
Links to existing works	The NSW government proposed Planning Bill 2013											
Commencement	2015											
Costs, Resources and Funding Opportunities	Initial negotiations											
Lead Responsibilities	Council											
Support Responsibilities	The Hills Shire Council, Hornsby Council											
Performance Measures	1. Working group discussed by relevant Councils											

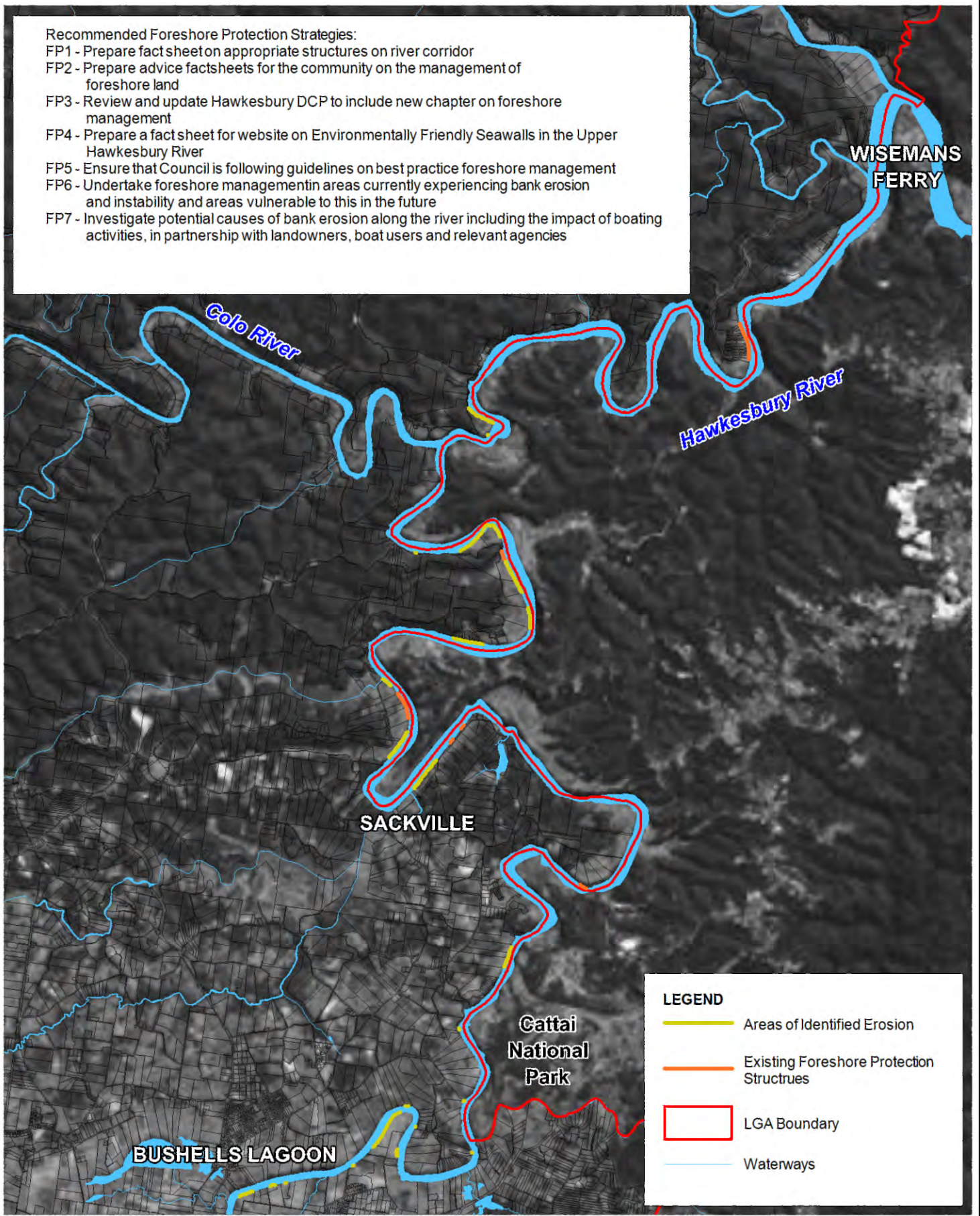
Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

3.5 Foreshore Protection Sub-Plan

FORESHORE PROTECTION SUB-PLAN

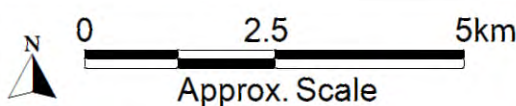
Recommended Foreshore Protection Strategies:

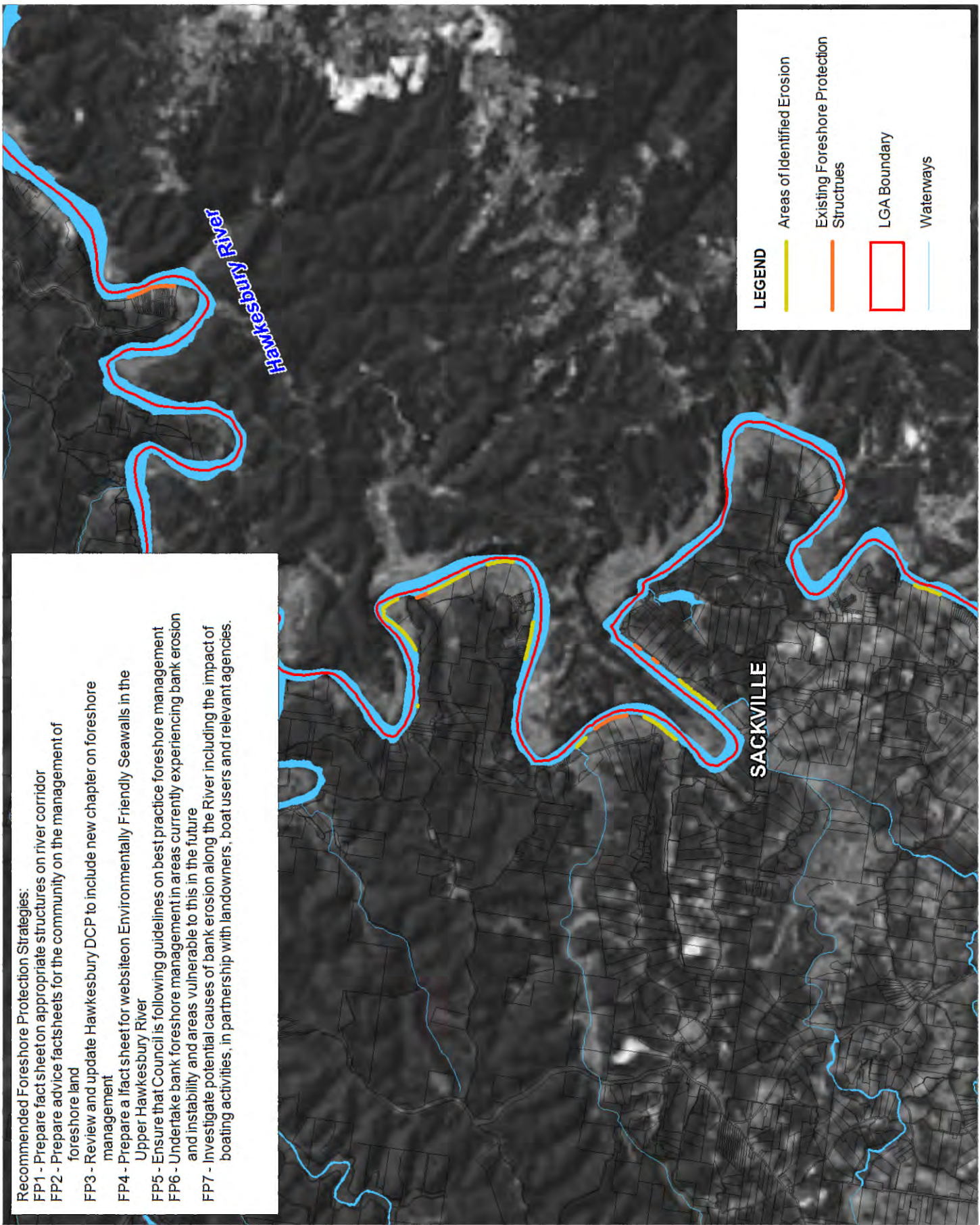
- FP1 - Prepare fact sheet on appropriate structures on river corridor
- FP2 - Prepare advice factsheets for the community on the management of foreshore land
- FP3 - Review and update Hawkesbury DCP to include new chapter on foreshore management
- FP4 - Prepare a fact sheet for website on Environmentally Friendly Seawalls in the Upper Hawkesbury River
- FP5 - Ensure that Council is following guidelines on best practice foreshore management
- FP6 - Undertake foreshore management in areas currently experiencing bank erosion and instability and areas vulnerable to this in the future
- FP7 - Investigate potential causes of bank erosion along the river including the impact of boating activities, in partnership with landowners, boat users and relevant agencies



<p>Title: Foreshore Protection Sub-Plan: Upper Hawkesbury River (lower reaches)</p>	<p>Figure: 3-9</p>	<p>Rev: E</p>
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BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.





Recommended Foreshore Protection Strategies:
 FP1 - Prepare fact sheet on appropriate structures on river corridor
 FP2 - Prepare advice factsheets for the community on the management of foreshore land
 FP3 - Review and update Hawkesbury DCP to include new chapter on foreshore management
 FP4 - Prepare a fact sheet for website on Environmentally Friendly Seawalls in the Upper Hawkesbury River
 FP5 - Ensure that Council is following guidelines on best practice foreshore management
 FP6 - Undertake bank foreshore management in areas currently experiencing bank erosion and instability and areas vulnerable to this in the future
 FP7 - Investigate potential causes of bank erosion along the River including the impact of boating activities, in partnership with landowners, boat users and relevant agencies.

LEGEND

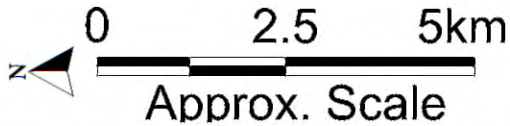
- Areas of Identified Erosion
- Existing Foreshore Protection Structures
- LGA Boundary
- Waterways

Title:
**Foreshore Protection Sub-Plan:
 Upper Hawkesbury River (upper reaches)**

Figure:
3-10

Rev:
D

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FP1	Prepare fact sheet on appropriate structures on river corridor										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Council					Priority		High			
Focus Area / Approach Category	Development Services					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>This would be an internal document for use by HCC staff. This action would involve taking information provided by the NSW Government's environmentally sensitive seawall guidelines and BMT WBM (2013b) and prepare guidelines specific to the Upper Hawkesbury River Estuary.</p> <p>It is important that the question of whether a structure is required is addressed early in the development assessment process and that where possible, soft engineering approaches are used. The fact sheet should emphasise the use of natural treatment to avoid the proliferation and cumulative impacts of hard engineering structures along the river.</p> <p>Information to be included would be:</p> <ul style="list-style-type: none"> • How to maximise the use of native foreshore and estuarine vegetation • Create walls of boulders of varying sizes and shapes, or irregularly shaped to increase habitat potential • Where possible, avoid the construction of vertical seawalls 										
Links to existing works	<p>Environmentally Friendly Seawalls: A guide to improving the Environmental Value of Seawalls and Seawall lined Foreshores in Estuaries (CMA 2009)</p> <p>Site specific guides used by other Councils such as Hornsby and Pittwater</p> <p>Draft Guidelines for Assessing Impacts of Seawalls (DECCW 2010)</p>										
Commencement	Within 2 years										
Costs, Resources and Funding Opportunities	Minimal Cost										
Lead Responsibilities	HCC										
Support Responsibilities	OEH										
Performance Measures	<ol style="list-style-type: none"> 1. Checklist for Council Planners prepared 2. Checklist being used for DA assessments 3. All approved structures consistent with guidelines within 5 years 										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

FP2	Prepare advice factsheets for the community on the management of foreshore land										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Council					Priority		High			
Focus Area / Approach Category	Development Services					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>Prepare advice factsheets regarding the management of foreshore land including emphasis utilising native vegetation as a primary means for bank protection, and general information on acceptable bank management techniques and approaches.</p> <p>As “deliberate clearing of riparian land” is a threat/issue to be addressed in the CZMP, it recommended the community fact sheet includes information on this, outlines that it is illegal to clear native riparian vegetation and lists the relevant legislation under which this may be an offence. The fact sheet could also include contact details where the community can report instances of illegal clearing.</p> <p>The factsheets should target different groups within the community. The Hawkesbury LGA has a community which has a diversity of cultures and language.</p> <p>The advice factsheets should be made available for community members looking to submit DAs.</p>										
Links to existing works	Information packages sent out with DA assessment forms										
Commencement	2-5 years										
Costs, Resources and Funding Opportunities	Minimal costs to be absorbed by Council										
Lead Responsibilities	Council										
Support Responsibilities	OEH, Other Councils										
Performance Measures	1. Fact sheets prepared and distributed										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

FP3	Review and update Hawkesbury DCP to include a new chapter on foreshore management										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Council					Priority		High			
Focus Area / Approach Category	Strategic Planning					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>The DCP needs updating and there are some opportunities to improve wording and information for benefit of the Upper Hawkesbury River Estuary. For example, Section 4.5 of the DCP refers to the former DLWC and Section 4.6 on appropriate vegetation does not include recommendations specifically for riparian areas.</p> <p>The DCP should include a range of considerations such as:</p> <ul style="list-style-type: none"> • Consider alternative options to hard structures such as native vegetation and temporary wave barriers. • Maximising the incorporation of native riparian and estuarine vegetation into the structure. • Maximising habitat diversity and complexity by incorporating microhabitats such as pools, crevices, boulders and ledges, and by maximising surface roughness and texture. • Creating low-sloping seawalls or incorporate changes of slope to maximise habitat surface area. 										
Links to existing works	<p>Riverbank Protection Project Information Sheets available from GSLLS</p> <p>Environmentally Friendly Seawalls: A guide to improving the Environmental Value of Seawalls and Seawall lined Foreshores in Estuaries (CMA 2009)</p> <p>Draft Guidelines for Assessing Impacts of Seawalls (DECCW 2010)</p> <p>Wollongong City Council DCP 2009 - Chapter E23 - Riparian Land Management</p> <p>Ku-ring-gai Council Local Centres DCP 2013 - Volume B part 5 – Riparian</p> <p>Fairfield City Council – Fairfield City Wide DCP 2013 – Chapter 3 Environmental Management and Constraints – 3.4 – Riparian land and waterways</p>										
Commencement	Immediate										
Costs, Resources and Funding Opportunities	Requires Council staffing and budget										
Lead Responsibilities	Council										
Support Responsibilities	OEH										
Performance Measures	<ol style="list-style-type: none"> 1. DCP modified 2. All new structures compliant with DCP within 5 years 										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

FP4	Prepare a factsheet for website on Environmentally Friendly Seawalls in the Upper Hawkesbury River										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Numerous					Priority		High			
Focus Area / Approach Category	Development Services and Strategic Planning					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>In the short term the generic brochure prepared by OEH should be included in DA information packs. There should also be a link to the brochure added to Council's website immediately.</p> <p>A site specific brochure with examples and species appropriate to the study area and translated for the diversity of cultural and language groups within the Hawkesbury LGA should be developed. These brochures should be distributed to all riverside land owners in the first instance. The brochure should be added to Councils website, be available at Council offices and libraries as appropriate and be included in DA information packs.</p> <p>It is important that the site specific brochure promotes the use of natural treatments (such as native vegetation and temporary wave barriers / soft treatments) for bank protection in the first instance, and that seawalls should only be used where it has been assessed that active erosion requires such treatment.</p> <p>Under the Riverbank Protection Project a range of Information Sheets relevant to this were prepared including:</p> <ul style="list-style-type: none"> • The role of riverbank vegetation • Demonstration Sites - Hawkesbury Park, North Richmond • Reeds to the rescue • Riverbank planting guide: • Richmond-Windsor floodplain 										
Links to existing works	Generic OEH brochure is available at http://sydney.cma.nsw.gov.au/component/remository/func-startdown/316/ Riverbank Protection Project Information Sheets available from GSLLS										
Commencement	Immediate distribution of generic brochure. Tailored brochure available within 5 years										
Costs, Resources and Funding Opportunities	Printing costs only for generic brochure, allow \$5000 in the first year. Design and printing of site specific brochure and translation into other languages within 5 years. Allow \$45,000 for this.										
Lead Responsibilities	Council										

FP4	Prepare a factsheet for website on Environmentally Friendly Seawalls in the Upper Hawkesbury River
Support Responsibilities	OEH, GSLLS
Performance Measures	<ol style="list-style-type: none"> 1. Generic brochures being actively disseminated 2. Site specific brochure designed and printed

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

FP5	Ensure that Council is following guidelines on best practice foreshore management										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Council					Priority		High			
Focus Area / Approach Category	Parks and Recreation					Applicable to		All study zones (Estuary wide)			
Detailed Description	<p>Council should lead the way with best practice foreshore protection and rehabilitation. A good opportunity for this includes the work to be undertaken at Holmes Drive Reserve. Demonstration days could be held where residents are invited to come along and see the works being undertaken.</p> <p>As outlined in previous strategies all works undertaken should adhere to the principles of:</p> <ul style="list-style-type: none"> • Considering alternative options to hard structures such as native vegetation and temporary wave barriers. • Maximising the incorporation of native riparian and estuarine vegetation into the structure. • Maximising habitat diversity and complexity by incorporating microhabitats such as pools, crevices, boulders and ledges, and by maximising surface roughness and texture. • Where seawalls are deemed appropriate, creating low-sloping seawalls or incorporate changes of slope to maximise habitat surface area. 										
Links to existing works	<p>Holmes Drive Reserve POM Government Philip Reserve Bank Stabilisation GSLLS has a broad range of fact sheets available that will support this action</p>										
Commencement	Immediate										
Costs, Resources and Funding Opportunities	May increase project costs in some instances										
Lead Responsibilities	Council, GSLLS										
Support Responsibilities	OEH										
Performance Measures	1. Independent assessment of Council works by OEH at end of projects.										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

FP6	Undertake foreshore management in areas currently experiencing bank erosion and instability and areas vulnerable to this in the future.										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Council					Priority		Moderate			
Focus Area / Approach Category	Parks and Recreation					Applicable to		Windsor to Sackville			
Detailed Description	<p>In any foreshore management exercises, Council should first ascertain if a structure is necessary and consider alternative options to hard structures such as native vegetation and temporary wave barriers.</p> <p>Council should undertake bank management on publicly owned land and support works on privately owned land.</p> <p>Costs associated with design, assessment, approvals and construction of erosion management works is likely to be high (many \$m). For this reason, the first step in implementing this option will be the prioritisation of works in order to optimise limited funding that would be available for this strategy.</p> <p>Government grants that may be available for erosion management would include the NSW Estuary Management Program, and Federal Caring for Our Country (providing there is a substantial riparian revegetation and rehabilitation component as part of the works, i.e. Environmentally Friendly seawalls, or a combination of hard and soft erosion measures).</p> <p>This CZMP should be submitted to RMS for consideration in any future regional Boating Plans of Management</p>										
Links to existing works	BMT WBM 2013b – mapping to be used for prioritisation and as a baseline for future monitoring										
Commencement	2-5 years										
Costs, Resources and Funding Opportunities	Depending on the height of the riverbank, erosion management works can cost in the order of \$1,000 - \$3,000 per lineal metre. Thus protection of a 100m long section of river could cost in the order of \$300,000 or more.										
Lead Responsibilities	Council										
Support Responsibilities	OEH, Crown Lands, GSLLS										
Performance Measures	<ol style="list-style-type: none"> 1. Length of eroded foreshore treated with erosion works 2. No net increase in length of eroded bank in 5 years 										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

FP7	Investigate potential causes of bank erosion along the River including the impact of boating activities, in partnership with landowners, boat users and relevant agencies.										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
	✓	✓							✓		
Suggested by	DPI					Priority		Moderate			
Focus Area / Approach Category	Parks and Recreation and Strategic Planning					Applicable to		Windsor to Sackville			
Detailed Description	<p>It is recognised that certain recreation boating activities may be linked to adjacent bank erosion. Council will investigate potential causes of erosion in partnership with the landowners and boaters.</p> <p>RMS has developed Safe Boating Plans (or their equivalent) for a number of rivers and estuaries in NSW which aim, in part, to minimise the impact of boat wash on bank erosion (e.g. Shoalhaven River, Williams River, Georges River).</p>										
Links to existing works	BMT WBM 2013b – mapping to be used for prioritisation and as a baseline for future monitoring										
Commencement	2-5 years										
Costs, Resources and Funding Opportunities	Requires Council staffing and budget										
Lead Responsibilities	Council										
Support Responsibilities	RMS,OEH, Crown Lands, GSLLS, Hornsby Council										
Performance Measures	<p>3. Length of eroded foreshore treated with erosion works</p> <p>4. No net increase in length of eroded bank in 5 years</p>										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

3.6 Cultural Heritage Sub-Plan

CULTURAL HERITAGE SUB-PLAN

CH1	Work with the LALC and elders to identify opportunities to maximise benefits of rehabilitation works for cultural outcomes.										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Local Aboriginal Land Council (LALC)				Priority			Moderate			
Focus Area / Approach Category	Parks and Recreation					Applicable to		All Zones (Estuary Wide)			
Detailed Description	<p>Deerubbin LALC is committed to working for the protection and promotion of Aboriginal culture and heritage in its area.</p> <p>The LALC has undertaken significant and ongoing rehabilitation works on riparian lands along the estuary and within the wider catchment. This has involved a cooperative effort with the Willow Warriors on some occasions. Conservation and Land Management Training has been undertaken by members of the Aboriginal community in the last few years and accreditation has been achieved at various levels by nine individuals.</p> <p>Much of the riverside land downstream of Yarramundi is privately owned and there are very few sites recorded in the Aboriginal History and Information Management System (AHIMS) register in this area. This demonstrates the limitations of the mapping and the need to look at Aboriginal Cultural Heritage beyond individual sites as the connection of people to land, of taking a landscape perspective.</p> <p>Discussions between the Deerubbin LALC, GSLLS and Council should be undertaken to determine if there is opportunity to broaden rehabilitation works to include Aboriginal assessments, particularly on land that has had limited access.</p>										
Links to existing works	Rehabilitation works undertaken by Aboriginal Green Teams										
Commencement	Within 2 years										
Costs, Resources and Funding Opportunities	This initiative may attract funding from a range of state and government sources (including health). Costs may be \$30,000 for a pilot project.										
Lead Responsibilities	Council										
Support Responsibilities	LALC, GSLLS										
Performance Measures	1. Pilot project involving riverside rehabilitation and Aboriginal assessment undertaken and reported upon										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

CH2	Protect and enhance cultural heritage values.										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Willow Warriors					Priority	Moderate				
Focus Area / Approach Category	Parks and Recreation					Applicable to	All Zones (Estuary Wide)				
Detailed Description	<p>The area covered by the CZMP contains some significant post colonisation heritage sites. Where consistent with the Coastal Management Principles outlined in Section 1.4 of this CZMP, efforts to protect and enhance these values should be undertaken.</p> <p>An example of a former project that met this criteria is a joint project between the Willow Warriors and a local historical society who were trying to protect historical sites being overrun and broken up by willows and other weeds.</p>										
Links to existing works	Willow control project at Wingecarribee River										
Commencement	Within 2 years										
Costs, Resources and Funding Opportunities	This initiative may attract funding from a range of state and government sources										
Lead Responsibilities	Council										
Support Responsibilities	Local Historical Societies, GSLLS, Willow Warriors										
Performance Measures											

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

3.7 Sea Level Rise Sub-Plan

SEA LEVEL RISE SUB-PLAN

SLR 1	Incorporate Sea Level Rise considerations into infrastructure and asset management planning processes and capital works design										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
						✓					
Suggested by	Study Team					Priority	Moderate				
Focus Area / Approach Category	Information Services					Applicable to	All Zones (Estuary Wide)				
Detailed Description	<p>Climate change is one of many aspects that need to be considered when planning how assets will be managed and when they will be upgraded. Where assets are being replaced, this strategy provides that care is taken to make sure the design is within the confines of projected climate change (and particularly sea level rise). Sea level rise may also be the trigger for asset replacement in some instances as we move into the future.</p> <ul style="list-style-type: none"> • Identify the riparian lands likely to be affected by sea level rise over an appropriate asset planning period (say 50 – 100 years); • Identify all assets along the River within the areas predicted to be affected by SLR. • Incorporate future SLR risks into Council’s Asset Management Program for these assets to ensure that any future works (maintenance, replacement etc) account for potential future changes to river hydrology and groundwater conditions. <p>Note that a rigorous assessment of sea level rise implications for the study area has not yet been undertaken.</p> <p>Refer also to Action WQ7 in regard to potential impacts on irrigation and stock watering resulting from changes to the salinity profile. Impacts on aquatic vegetation and habitats should also be considered.</p>										
Links to existing works	SLR mapping of the Sydney Basin by CSIRO										
Commencement	Within 5 years										
Costs, Resources and Funding Opportunities	Minimal costs to include consideration of sea level rise into existing Council processes. Modelling and mapping of sea level rise has not been costed here.										
Lead Responsibilities	Council										
Support Responsibilities	OEH										
Performance Measures	1. Sea level rise provisions included in infrastructure and asset management programs										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

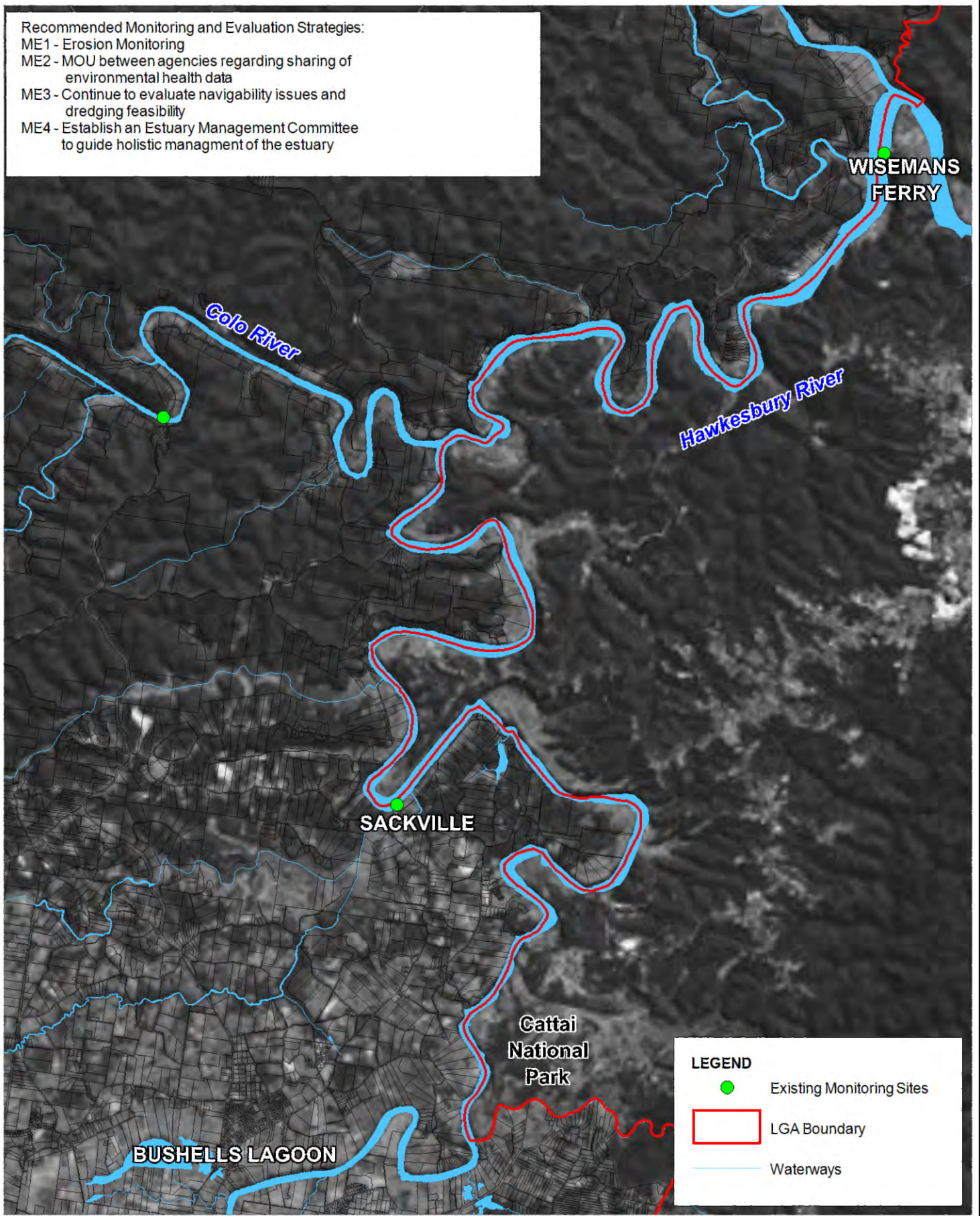
SLR 2	Map wetland vegetation and assess vulnerabilities to future sea level rise										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
						✓					
Suggested by	Study Team					Priority	Moderate				
Focus Area / Approach Category	Strategic Planning (and Parks and Recreation)					Applicable to	All Zones (Estuary Wide)				
Detailed Description	<p>Identify wetland species or communities that are vulnerable to sea level rise and prioritise opportunities for landward migration.</p> <p>Identify areas that the vegetation will likely migrate into under the influence of SLR so that these areas can be protected in the future to avoid landuse conflicts. Could also feed into landuse planning and even DCP controls etc.</p> <p>Before this action is undertaken, an assessment of sea level rise implications for the river should be undertaken as described in WQ7</p>										
Links to existing works											
Commencement	Within 5 years										
Costs, Resources and Funding Opportunities	Allow \$50,000										
Lead Responsibilities	Council										
Support Responsibilities	NPWS, OEH										
Performance Measures	1. Vegetation mapped and prioritised										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

3.8 Monitoring and Evaluation Sub-Plan

MONITORING AND EVALUATION SUB-PLAN

Recommended Monitoring and Evaluation Strategies:
 ME1 - Erosion Monitoring
 ME2 - MOU between agencies regarding sharing of environmental health data
 ME3 - Continue to evaluate navigability issues and dredging feasibility
 ME4 - Establish an Estuary Management Committee to guide holistic management of the estuary

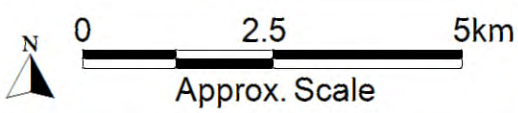


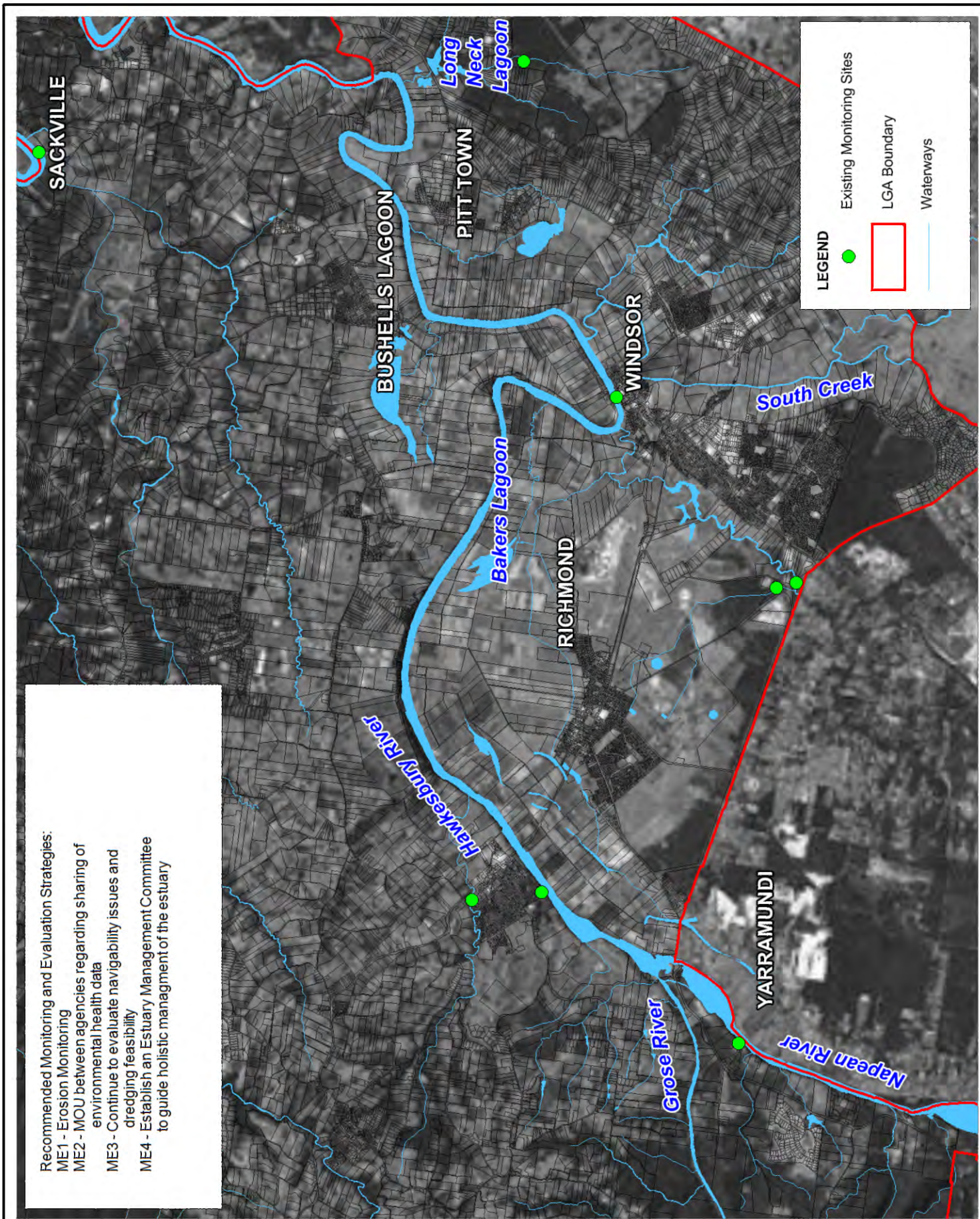
Title:
**Monitoring and Evaluation Sub-Plan:
 Upper Hawkesbury River (lower reaches)**

Figure:
3-11

Rev:
B

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





Recommended Monitoring and Evaluation Strategies:

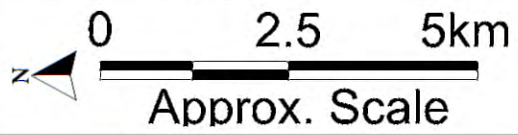
- ME1 - Erosion Monitoring
- ME2 - MOU between agencies regarding sharing of environmental health data
- ME3 - Continue to evaluate navigability issues and dredging feasibility
- ME4 - Establish an Estuary Management Committee to guide holistic management of the estuary

Title:
**Monitoring and Evaluation Sub-Plan:
 Upper Hawkesbury River (upper reaches)**

Figure:
3-12

Rev:
C

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



ME 1	Erosion Monitoring											
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K	
Suggested by	Study Team						Priority	High				
Focus Area / Approach Category	Strategic Planning						Applicable to	Yarramundi to Wisemans Ferry				
Detailed Description	<p>Mapping and assessment of foreshore erosion, structures and <i>Arundo donax</i> (a significant environmental weed for the study area) was undertaken parallel to preparation of the CZMP (2013).</p> <p>The mapping and assessment involved:</p> <ul style="list-style-type: none"> • Water-based field data collection of bank erosion, foreshore structures and <i>Arundo</i> along the Hawkesbury River between Yarramundi and Wisemans Ferry; • Collation of field data and preparation of spatial datasets for presentation and analysis in a GIS; • Mapping, analysis, interpretation and reporting of spatial datasets and other existing datasets relevant to the study; and • Discussion of the results of the field data with key findings of relevant studies and reports. <p>The mapping and assessment exercise should be repeated in 2018 to indicate on-going changes in a number of key environmental parameters. Finer scale erosion monitoring should be undertaken at key sites. These priority sites for detailed cross sections could include examples for Zones A, B and C in BMT WBM 2013b. The sites should include a variety of classes and slopes as well as adjoin land uses. Sites should also include areas where rehabilitation is being trialled as well as those where it is not.</p> <p>The methodology used will be determined at the time according to current best practice and available time and resources. More frequent use of LiDAR based technologies is expected in the coming years and is likely to provide very efficient collection of detailed data. Hornsby Council and the Lower Hawkesbury Estuary Management Committee have been undertaking erosion monitoring and application of new technologies. It would be beneficial for the Upper Hawkesbury to coordinate efforts and to adapt to lessons learnt from experiences in the lower estuary.</p>											
Links to existing works	BMT WBM (2013b)											
Commencement	2018											
Costs, Resources and Funding Opportunities	Allow \$50,000											
Lead Responsibilities	Council											

ME 1	Erosion Monitoring
Support Responsibilities	RMS
Performance Measures	<ol style="list-style-type: none"> 1. Monitoring undertaken 2. Monitoring evaluated and reported, with comparison to 2013 results 3. Management approach adapted in response to results

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

ME2	MOU between agencies regarding sharing of environmental health data										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
Suggested by	Council					Priority	Moderate				
Focus Area / Approach Category	Infrastructure Services					Applicable to	All Zones (Estuary Wide)				
Detailed Description	There are many agencies with responsibility for the management of the Upper Hawkesbury River Estuary. Effective management would benefit from having all environmental health data collected by these agencies located within a central repository. This option requires the establishment of an MoU between Sydney Catchment Authority, Sydney Water, Hawkesbury City Council, NSW Fisheries, the Office of Environment and Heritage and adjoining Councils and any other agencies collecting environmental data to openly share this data and compile a central database that can be accessed by all agencies responsible for river health management.										
Links to existing works	Existing Environmental Data Collection programs ME4 Estuary Management Committee										
Commencement	Within 2 years										
Costs, Resources and Funding Opportunities	Requires Council staffing and budget										
Lead Responsibilities	Council										
Support Responsibilities	SCA, DPI, Sydney Water, GSLLS, OEH, adjoining Councils										
Performance Measures	<ol style="list-style-type: none"> 1. MoU signed 2. Database being populated with historic and current environmental data 3. Agencies accessing and utilising the database for river management purposes. 										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

ME3	Continue to evaluate navigability issues and dredging feasibility											
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K	
Suggested by	Council					Priority		Moderate				
Focus Area / Approach Category	Infrastructure Services					Applicable to						
Detailed Description	<p>Based on the available information dredging is not a recommended strategy for this CZMP. Dredging is not supported by a recent navigation investigation undertaken on HCCs behalf. The recent hydrosurvey and navigability assessment undertaken by Worley Parsons (2012) indicates that the river bed dynamic and the channel thalweg is changing, but at a slow rate. The current depths are considered appropriate for safe navigation. Dredging is also expensive and has the potential for adverse environmental impacts. A business case considering the financial implications of dredging is being prepared by HCC separate to this CZMP. An environmental assessment would also be required if dredging is to be pursued in the future.</p> <p>Action ME3 involves the biennial monitoring of transects as undertaken in the Worley Parsons (2012) study to assess navigational requirements. If results indicate that the navigation requirements of a 50 m to 100 m fairway, with an acceptable channel bed level of -1.9 m to -2.1 m AHD and below (i.e. a minimum functional water depth of 1.8 m) are not present, then further assessment of dredging feasibility could be undertaken.</p> <p>Further assessment would include the following steps:</p> <ul style="list-style-type: none"> • Sediment sampling and analysis (see also work undertaken by Worley Parsons) • Detailed dredging design based on historical and new surveys, targeting recent catchment derived sediments. • Assessment of environmental constraints. Under the <i>Fisheries Management Act 1994 and Fisheries Management Amendment Act 1997</i>, a permit is required to carry out works of dredging or reclamation. 											
Links to existing works	Worley Parsons (2012) Navigability assessment											
Commencement	Within 2 years											
Costs, Resources and Funding Opportunities	\$20,000 biennially for monitoring (further environmental assessments, dredge design and dredging operations are not costed here).											
Lead Responsibilities	Council											
Support Responsibilities	RMS											
Performance Measures	1. Navigability Assessment undertaken and appropriate action taken											

ME4	Establish an Estuary Management Committee to guide holistic management of the Upper Hawkesbury Estuary										
Pressures / Issues Targeted (see key below)	A	B	C	D	E	F	G	H	I	J	K
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Suggested by	Council					Priority	High				
Focus Area / Approach Category	Strategic Planning					Applicable to					
Detailed Description	The implementation of the CZMP and future management of the Upper Hawkesbury River Estuary would be best supported by an Estuary Management Committee. The Committee should include at a minimum key stakeholders including public authority's representatives of local councils and representatives from the community. It is important the terms of reference are clearly defined. The Committee should meet 2-3 times per year. The Estuary Management Committee should be managed by Hawkesbury City Council.										
Links to existing works											
Commencement	Within 2 years										
Costs, Resources and Funding Opportunities	\$10,000 per year										
Lead Responsibilities	Council										
Support Responsibilities	OEH, GSLLS, DPI, The Hills Council, Hornsby Council, RMS, Sydney Water										
Performance Measures	<ol style="list-style-type: none"> 1. Committee established 2. Committee actively steering estuary management and implementation of CZMP 										

Key: A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

4 Monitoring and Evaluation

4.1 Considerations for Future Monitoring and Evaluation

4.1.1 Monitoring Design and the BACI concept

A good approach for assessing the status of the estuary in response to restoration actions is using a BACI (Before-After, Control-Impact) sampling framework (for example see Underwood 1992) to structure monitoring. A BACI structured approach involves examining the *Before* implementation Baseline and *After* implementation condition of a target area as well as using a *Control* (reference site) in addition to the *Impact* site (restoration target area). While the *Before* and *After* sampling helps determine how the site has changed during plan implementation, control and impact sampling will allow effects of restoration actions to be discerned from natural variability or other confounding factors.

In designing the monitoring strategy above and also the performance measures described within the action plan, the BACI structured approach has been integrated where possible.

4.1.2 Before- Establishing Baseline Data

A key focus for the monitoring program is to collect data now that can be used along the implementation time line to assess the performance of the plan in the future. Most environmental processes involve intra seasonal variability and require long term data on natural processes and patterns before the effects of individual management actions could begin to be assessed. There are, however some indicators that could be collected now to build baseline knowledge. The collection of this information now provides the opportunity for informing an adaptive management approach. Some baseline mapping has been undertaken already as a part of earlier stages of the project. Recommended baseline mapping includes:

- Erosion mapping (baseline already collected, refer to BMT WBM, 2013b)
- Foreshore structure Mapping (baseline already collected, refer to BMT WBM, 2013b)
- Weed mapping (baseline of *Arundo donax* along the main river between Wiseman Ferry and Windsor)
- Snapshot audit of compliance of construction sites within the catchment with sediment management
- Stormwater quality monitoring and monitoring of WSUD devices following events and on a regular basis

Care will be needed to make sure data collection and categorisation techniques are clearly outlined to allow sampling to be repeated in the future.

4.1.3 Holistic Considerations

Management of estuaries and other wetland systems has historically been guided by the National Strategy for Water Quality and associated ANZECC Marine and Freshwater Water Quality Guidelines (2000). These documents are underpinned by the approach of identifying the

Monitoring and Evaluation

environmental values of water (usually in consultation with the community) and then deriving appropriate water quality guidelines or objectives to protect these values using reference sites and other monitoring data. Water quality objectives are usually a measurable indicator or parameter of water chemistry such as nutrients, sediments or toxicants. This approach restricts the understanding of variability within and between estuarine systems.

In recent years, particularly amongst wetland and estuary managers, a more holistic approach to management has been developing. This approach seeks to not only look at the water quality of these systems but more broadly at the ecological character of the wetland and estuarine systems. Ecological character can be defined as the combination of the ecosystem components, processes, benefits and services that characterise the wetland at a given point in time (Ramsar Convention 2005a, Resolution IX.1 Annex A).

In terms of estuary management in NSW, it has also been recognised that the parameters and ranges described by the water quality guidelines are too narrow to describe the natural variability within and between estuarine systems. Many of the estuary systems are modified compared with their natural state, in response to which the original ecological character has changed. Furthermore, the modified ecological character is often what is valued from an ecosystem perspective, and so a return to the natural condition is not always a key objective, and indeed it is not possible to define the change in ecological character as either bad or good.

4.1.4 Adaptive Management

Monitoring needs to be strategic with results directly advising maintenance and education activities. Some examples of where this can apply are:

- Monitoring of WSUD devices with results influencing Councils maintenance program;
- Monitoring of foreshore management on private lands with results influencing education strategies, guidelines and DA assessments;
- Water quality monitoring for public health indicators influencing recreation planning;
- Continuing documentation of implementation including challenges (funding, logistics, community concerns etc.) achievements and failures to inform adaptive management

4.2 MERI Framework for Evaluation

A *Monitoring, Evaluation, Reporting and Improvement (MERI)* framework has been adopted by many government agencies to help establish the benefits being achieved through various grant programs. In principle, MERI is a method used to help understand how the design and delivery of natural resource management projects and programs can be improved.

The MERI approach is simple and practical practice for environmental works and has been considered through the monitoring and evaluation program described in the present document.

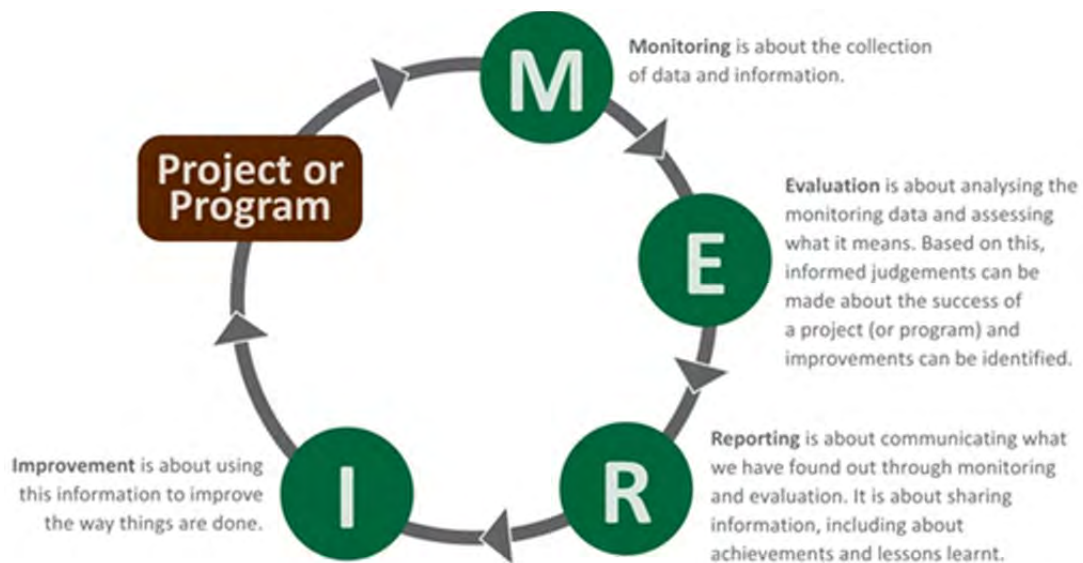


Figure 4-1 Monitoring, Evaluation, Reporting and Improvement Cycle

It is a requirement of the Coastal Zone Management Plan Guidelines (NSW Government, 2013) that an estuarine monitoring program, consistent with the NSW Natural Resources Monitoring, Evaluation and Reporting (MER) Strategy is included within the CZMP. Action WQ8 is for the implementation of an estuary health monitoring program include biennial report card preparation.

4.3 Indicators for Monitoring

The adopted estuary health monitoring program should be based on key indicators that are monitored at the State level under the MER Program. Through earlier phases of the project, effort has been directed toward identifying indicators that:

- Reflect the values and threats to these
- Provide outputs that are easy to interpret
- Respond predictably to threats
- Relate to appropriate scales of time and space
- Are easy/ cost effective to measure

Consideration has been given to the range of parameters and indicators that best meet these criteria and a suggested schedule is included as Table 4-1. The targets outlined here are based on the best available information at the time of report preparation. Review of available data is included in the Synthesis Report (refer to Section 1). Where these are not met, an assessment of the reasons should be undertaken to support improved management into the future.

Action WQ8 within the Action Plan given in Chapter 3 refers to Water Quality Monitoring.

Monitoring and Evaluation

Table 4-1 Monitoring Schedule

Parameter	Values the indicator reflects	Threats / Pressures the indicator reflects**	Methodology	Timing	Target
Bank Erosion	Fish habitat values Natural Bushland / riparian vegetation Aesthetic beauty	A, B, H	As per BMT WBM 2013b for broad scale with fine scale measuring of profiles for key sites	Audit 5 years after Plan implementation	Grading doesn't deteriorate (anything equal or better is a good outcome)
Foreshore structures	Fish habitat values Natural Bushland / riparian vegetation Aesthetic beauty	A, B, H	As per BMT WBM 2013b	Audit 5 years after Plan implementation	80% of new structures compliant with guidelines. Reduction in number of structures that are categorised as being made from concrete or tyre Replacement of any tyre or concrete structures with compliant structure
Water Quality – dissolved oxygen	Commercial fishing Fish Habitat	C, D, H, J, K	Continuation of current monitoring program	Regular sharing of data collected	Reduction in instances of DO less than 3mg/L *in the vicinity of confluence with South Creek and Cattai Creek
Water Quality - Salinity	Water source for agricultural users Fish Habitat Commercial Fishing	K,F,J,C	Continuation of current monitoring program	Regular sharing of data collected	Analyse baseline and changes for frequency of days where >5ppt (estimated to currently be 35% of the time at Wisemans Ferry)

Monitoring and Evaluation

Parameter	Values the indicator reflects	Threats / Pressures the indicator reflects**	Methodology	Timing	Target
Algal Blooms species, frequency extent	Commercial fishing Water bird habitat Recreational opportunities Fish habitat	K,F,J,C	As per MER		
Macroinvertebrates	Commercial fishing Water bird habitat Recreational opportunities Fish habitat		Adaptive management approach required. There is almost 10 years of data available and while researchers are not yet confident enough of cause and effect to use as indicator, Sydney catchment Authority and others are working on		
Weeds Arundo	Fish habitat values Natural Bushland / riparian vegetation Aesthetic beauty	A, B, H	Repeat methodology undertaken in BMT WBM 2013 b	2 ½ years and 5 years	
Environmental Flows	All values	C J K			

Notes:

*1 mg/L lethal to prawns (Pinto 2012), 3mg/L lethal to most fish (DPI Fisheries 2012)

**A=Riparian Land use; B=Water based development; C=Catchment land uses; D=Weed invasion in riparian areas; E=Illegal dumping of waste; F=Sea level rise; G=Sediment supply; H=Boat based activities; I=Private ownership of foreshore land; J=STP discharges; K=Water extraction & dams

4.4 Evaluation and Reporting

Evaluation of the data is important for determining whether any priorities in the CZMP need to be amended or specific actions need to be taken. Evaluation should be an ongoing process.

Reporting of the data is important for highlighting to key stakeholders and the community in general how the health of the estuary is changing over time and compares to other estuaries. Reporting should be in the form of yearly report cards on estuary health / water quality.

4.5 Plan Review

It is recommended that this CZMP be reviewed every two years, to determine progress with individual actions and strategies, while a broader audit and update be conducted every 5 years. The biennial review should focus on funding, resources and barriers to implementation of the individual actions and strategies, whereas the 5 year audit should target re-evaluation of values, processes and threats to determine progress with overall aims and objectives. From the 5 year audit, changes can be made to the Plan to ensure the document remains current, and relevant to the community uses and understanding of estuarine processes

5 References

- ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand. Canberra, Australia.
- BMT WBM (2013a) Upper Hawkesbury River Estuary Synthesis Report
- BMT WBM (2013b) Upper Hawkesbury River Bank Erosion, Foreshore Structure and Weed Mapping
- BMT WBM (2013c) Upper Hawkesbury River CZMP Community Consultation Report
- Catchment Management Authority (2009) Environmentally Friendly Seawalls: A guide to improving the Environmental Value of Seawalls and Seawall lined Foreshores in Estuaries
- Department of Environment and Climate Change (2009) Hawkesbury – Nepean River Environmental Monitoring Program
- Department of Environment and Climate Change (2009) Draft Lower Hawkesbury Nepean River nutrient management strategy
- Department of Environment Krogh. M., Wright. A. and Miller. J. (2009). Hawkesbury-Nepean River Environmental Monitoring Program. Final Technical Report. NSW Department of Environment and Climate Change.
- Landcom (2004) Soils and Construction – Managing Stormwater (Bluebook) – 4th Edition
- NSW Department of Environment Climate Change and Water (2009), *Derivation of the NSW Government's sea level rise planning benchmarks*, Technical Note, October 2009
- Department of Primary Industries (2006) Reducing Impact of Road Crossings on Aquatic Habitat in Coastal Waterways of the Hawkesbury Nepean
- Land and Water Australia (2006) Stock and Waterways
- Pinto, U., Maheshwar, B.L., Shrestha, S., and Morris, C. (2012) Understanding the meaning of river health for a community: perspectives from the peri-urban region of the Hawkesbury-Nepean catchment, *Australia Water Policy* 14 (2012) 766-783
- Tucker (2011) Building staff capacity: the key to erosion and sediment control NSW Coastal Conference Proceedings
- WBM (2006) Brooklyn Estuary Management Plan prepared for Hornsby Shire Council

6 Acronyms

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
CZMP	Coastal Zone Management Plan
DA	Development Assessment
DCP	Development Control Plan
DoPI	NSW Department of Planning and Infrastructure
DPI	Department of Primary Industries
EPA	Environment Protection Authority
GPT	Gross Pollutant Trap
GSLLS	Greater Sydney Local Land Services
HCC	Hawkesbury City Council
HNCAP	Hawkesbury Nepean Catchment Action Plan
HRCC	Hawkesbury River County Council
HSC	Hornsby Shire Council
LALC	Local Aboriginal Lands Council
LGA	Local Government Area
MERI	Monitoring, Evaluation, Reporting and Improvement
MOU	Memorandum of Understanding
NPWS	National Parks and Wildlife Service
OEH	Office of Environment and Heritage
POEO	NSW Protection of the Environment Operations Act 1997
POM	Plan of Management
RMS	Roads and Maritime Services
SLR	Sea Level Rise
STP	Sewage Treatment Plant
WSUD	Water Sensitive Urban Design (an approach to urban planning that integrates land and water planning and management into urban design)

Appendix A Prioritised Long List of Potential Management Options

Ref ID	Option	If so, please indicate where? If not, please indicate where the option could or should we implemented?	No Regrets?	Degree of threat addressed	Risk Reduction Potential	Timeframe	Cost	Practicality	Community Support	Certainty of Outcome	Equal Weighted Score	Weighted Score
16	Map caravan park locations - clearly defining regulations regarding caravan parks and identifying opportunities to reduce impacts/prevent further proliferation.	Every 5 years caravan parks need to apply for an Approval to Operate. They are issued with Conditions to Operate. As part of that process they could be required to develop a Landscape Management Plan for the site which would be consistent with Council guidelines that HCC could develop.									21	21
17	Council to adopt a policy of no CSG mining in the catchment										21	21
18	Clearly outline the relevant planning framework around water based development and identify opportunities to improve this to ensure appropriateness of future development.	Develop flowcharts and summary tools to explain the planning process									20	20.3
19	Ensuring that where Council is responsible for building structures that best practice is used.	Council set an example of Best Practice in structure design eg.Governor Phillip Park									20	20.3
20	Work from relevant priorities determined by the HNCAP 2013-23	Actions to be investigated and implemented where appropriate									20	20.3
21	Update development control plan to inform water based structure construction.	DCP to be updated upon finalisation of CZMP									20	20.3
22	Actively support the continuation of Bush care to assist with revegetation works on Public and Private Lands	Ongoing across LGA									20	20.3
23	Undertake bank erosion works in areas currently experiencing bank erosion and instability and areas vulnerable to this in the future . Council to undertake works on publically owned land and to support works on privately owned land	Undertaking works at Holmes Drive. Instream revegetation project at five reserves underway.									20	20.3

Ref ID	Option	If so, please indicate where? If not, please indicate where the option could or should we implemented?	No Regrets?	Degree of threat addressed	Risk Reduction Potential	Timeframe	Cost	Practicality	Community Support	Certainty of Outcome	Equal Weighted Score	Weighted Score
24	Undertake an education program for works staff involved in sediment and erosion control within the catchments to raise the profile of best practice erosion and sediment control, assist staff with new policies and procedures and track improvements in performance.	Engage a facilitator to develop a training program. Currently there is training in road side vegetation management.									20	20.3
25	Repeat erosion, foreshore structure and weed mapping undertaken for this project in 5 years time to assess changes										20	20.3
26	Mapping estuarine vegetation and identifying vulnerabilities.	More detailed mapping is required to define the extent of vegetation, type and vulnerabilities.									20	20.3
27	Develop educational materials and program to encourage best practice riparian land management.	Prepare Best Practice examples (using Environmentally Friendly Seawalls Brochure and Guidelines)									20	20.3
28	Increase compliance activity on the river for pollution / dumping. Increase public promotion of implications for offenders	Increase regularity of compliance inspections.									19	17.5
29	Demonstrate best practice land management on publically owned land.	Best practice land management at Governor Phillip Park									19	19.6
30	Consider employing a Riverkeeper.	Currently a phd university student is the River keeper. No results have been received.									19	19.6
31	Provide development assessment guidelines for subdivisions to maximise riparian corridors and reduce fragmented private frontages.	Provide development assessment guidelines for subdivisions to maximise riparian corridors and reduce fragmented private frontages.									19	18.55

Ref ID	Option	If so, please indicate where? If not, please indicate where the option could or should we implemented?	No Regrets?	Degree of threat addressed	Risk Reduction Potential	Timeframe	Cost	Practicality	Community Support	Certainty of Outcome	Equal Weighted Score	Weighted Score
32	Enforce implementation and maintenance of effective sediment controls during the subdivision and building phases of all developments (including infrastructure projects) by undertaking regular audits of developments during construction	Ongoing maintenance of sediment control during construction. Levy on new development will need to be implemented.									19	19.6
33	Undertake adequate and appropriate maintenance of existing WSUD devices to maintain their effectiveness, in particular GPTs, nutrient filters and other stormwater quality improvement devices.	GPT inspections and cleaning after rainfall events. Regular street sweeping programs.									19	19.6
34	Council led program to identify when riparian land changes ownership and to contact new owners making them aware of opportunities for grants to improve the condition of riparian lands. (related to 30)	How would we practically do this? HCC get Notice of Sale. Is there many sales?. Need to map all properties.									19	18.55
35	Pilot projects to showcase best practice riparian vegetation.	At Governor Phillip Park hard engineering examples are showcased. On the eastern bank of South Creek riparian planting.									19	19.6
36	Undertake compliance on unauthorised use and development on riparian and estuarine vegetation areas	Lobby Government to create an authority like Office of Hawkesbury Nepean.									19	17.5
37	Undertake bird and fauna surveys along the river to assess conservation value and inform future management	Surveys have been undertaken in the past. Contact local bird watchers and request they supply their data for a nominal fee.									19	18.55

Ref ID	Option	If so, please indicate where? If not, please indicate where the option could or should we implemented?	No Regrets?	Degree of threat addressed	Risk Reduction Potential	Timeframe	Cost	Practicality	Community Support	Certainty of Outcome	Equal Weighted Score	Weighted Score
38	When prioritising areas for rehabilitation, seek out opportunities to compliment riparian and biodiversity corridors.	The riparian and biodiversity corridor have been identified and mapped.									19	19.6
39	Water quality monitoring program at key locations as a first stage of the WSUD implementation feasibility study	As a first step establish a water quality program at key locations.									19	19.6
40	Utilise hydraulics and WQ modelling insights coming out of present study for Sydney Water to understand processes and impacts.	Pending Sydney Water study									19	19.6
41	Subject to permission being granted utilise model to assess impacts of Climate Change, changes to water sharing plan and potential impacts of options.	State government responsible for modelling. HCC to review results and incorporate as required									19	19.6
42	Have a compulsory riparian buffer of 100-200 metres	na									19	18.55
43	Identify wetland species and communities that will be impacted by sea level rise and prioritise opportunities for landward migration.	Would be good project to put in CZMP to undertake.									19	19.6
44	Lobbying state government by community and council regarding higher quality of water from discharges by Sydney Water.	Just addressed volume of flow									19	18.55
45	Lobby for stricter regulations for wakeboarding, for example restricting the use of ballast	RMS responsibility									19	18.55
46	Coordinating weed management efforts between the County Council, Bushcare and Landcare (including Willow Warriors) and the LALC to maximise benefits for the estuary.	Weed management is conducted across the LGA. Additional funding required to further expand the program.									18	17.85
47	Lobby for an increase environmental flows	Increasing environmental flows have been discussed by Council. Additional lobbying could be undertaken.									18	16.8

Ref ID	Option	If so, please indicate where? If not, please indicate where the	No Regre	Degree of	Risk Red	Timefram	Cost	Practicali	Communi	Certainty	Equal We	Weighted
48	Identify potential sources of pollutants (e.g.. Golf course, sedimentation hotspots and agricultural lands) and liaise directly with land owners/ managers to reduce nutrient and sediment inputs	First phase to identify hotspots and then conduct targeted education programs at key locations									18	17.85
49	Provide targeted education for landowners within the catchment	Prepare land use fact sheets and explain when consent is required									18	16.8
50	Implement specific POMs that have been prepared for key parks. Prepare and implement a Natural Habitat Restoration Strategy that identifies priority locations, how to restore land and increase access.	Specific POMs have been prepared for key parks. Generic POM cover smaller parks with similar issues. Natural Habitat Restoration Strategy should be prepared as a top down approach to identify priority locations, how to restore land and increase access									18	17.85
51	Retrofit appropriate WSUD in existing urban areas including measures such as artificial wetlands, vegetated swales	Investigation required to identify all storm water drains and land availability for WSUD devices. Water quality assessment should also be undertaken.									18	18.9
52	Reduce potential sewage contamination to the river, through identifying sources, increased auditing of on site systems and where possible, connect rural residential residences up to the sewer network	Septic Safe Program ongoing which includes issuing Approval to Operate Onsite Sewage Management Systems. 2009-10 saw the connection to a reticulated sewage scheme in Agnes Banks, Wilberforce, Freemands Reach and Glossodia. All areas complete. Ideally smaller lots in satellite villages like Kurragong, Kurrogiong Heights, Bowen Moutain should be connected to a reticulated sewerage scheme.									18	18.9

Ref ID	Option	If so, please indicate where? If not, please indicate where the option could or should we implemented?	No Regrets?	Degree of threat addressed	Risk Reduction Potential	Timeframe	Cost	Practicality	Community Support	Certainty of Outcome	Equal Weighted Score	Weighted Score
53	Provide information to private landholders that have key habitat and vegetation communities on their properties to describe the community, its importance to the river and options for its protection and management	Investiage options available to inform landholders - website, flyer, letters									18	17.85
54	Opportunities for improvement to Council management of onsite systems.										18	18.9
55	Upgratde STPs	Winmalee is owned by Sydney Water and not under HCC care. Richmond and North Richmond also owned by Sydney Water. South Windor STP upgraded previously. McGraths Hill STP maybe graded in next 10 years.									18	18.9
56	No sand mining in the catchment	Recent council resolution to not support sandmining in the catchment									18	16.8
57	Encourage the installation of filtration systems for runoff from farms (artificial wetlands) -refer to later option										17	17.15
58	Develop a monitoring strategy for key water quality parameters	Develop a monitoring program for key parametres at key locations.									17	17.15
59	Require proponents to justify the scale of works being proposed when submitting DA's. What is the scale of the associated works. If there is a DA application for a boat ramp why is a BBQ area and bank work needed?	see 21 above									17	16.1
60	Negotiate an MOU between Hawkesbury and Hills Councils to regulate development along the Upper Hawkesbury Estuary	Initiate discussions with Hills Council.									17	17.15

Ref ID	Option	If so, please indicate where? If not, please indicate where the option could or should we implemented?	No Regrets?	Degree of threat addressed	Risk Reduction Potential	Timeframe	Cost	Practicality	Community Support	Certainty of Outcome	Equal Weighted Score	Weighted Score
61	Lantana and other weed removal and subsequent rehabilitation of Half Moon Farm for public use.	Which cemetery is it the Sackville Cemetery??	✘	🟢	🟡	🟡	🟡	🟢	🟢	🟢	18	18.9
62	Council to Looby for an increase freshwater flows	Increasing environmental flows have been discussed by Council. Additional lobbying could be undertaken.		🟢	🟡	🔴	🟢	🟡	🟢	🟢	17	18.2
63	Capitalise on any opportunities to acquire privately owned foreshore lands, bringing them into public ownership to improve and enhance public access and ecological values.	No money available at this stage		🟢	🟢	🔴	🔴	🟢	🟢	🟢	17	18.2
64	Keep abreast of research on the relationship between environmental flow regime and estuary health.			🟢	🔴	🟢	🟢	🟢	🟡	🟡	17	16.1
65	Understand barriers to rehabilitation of privately owned banks and contribute to managing these.	The council would be prepared to work with interested landholders to rehabilitate land		🟢	🟡	🟡	🟡	🟡	🟢	🟢	17	18.2
66	Providing additional resources for compliance activities within Hawkesbury Council (see also option 14)	Increase regularity of compliance inspections. Lobby governments to create and authorit like the Office of Hawkesbury Nepean		🟢	🟡	🟢	🟡	🟢	🟡	🟡	17	16.1
67	Minimise the number of structures in a DA - i.e. not multiple access points evident at the caravan parks	see 21 above		🟢	🟡	🟢	🟢	🟡	🟡	🟡	17	16.1
68	Council continue to support research which improves understanding of river condition /cause and effect in order to develop improved management practices.	Support currently provided on an as needed basis.		🟢	🟡	🟡	🟡	🟡	🟡	🟡	15	14.7
69	Field days designed to remove carp from lagoons. Reintroduction of native species.	Recent competition to remove carp at St Albans Common. This competition could be expanded to include other lagoons.		🟡	🟡	🟢	🟡	🟢	🟡	🔴	15	13.65

Ref ID	Option	If so, please indicate where? If not, please indicate where the option could or should we implemented?	No Regrets?	Degree of threat addressed	Risk Reduction Potential	Timeframe	Cost	Practicality	Community Support	Certainty of Outcome	Equal Weighted Score	Weighted Score
70	Direct the community to appropriate waste facilities.	where??									15	13.65
71	Rehabilitation of barriers to fish passage.	DPI undertake rehabilitation on high priority sites but this has not occurred in the Hawkesbury									15	16.8
72	When determining DAs question why proponent needs a particular structure i.e. a boat ramp versus a pontoon. Boat ramp and associated works have a higher impact	Prepare fact sheet and DA assessment guidelines that require alternatives to be explored and justified.									15	14.7
73	Within DA determination question if the proponent used a holistic approach? Why haven't they looked at the whole river bank area and not left areas undeveloped that will then be impacted by erosion.	As per 21									15	14.7
74	Maximise potential of limited publically owned land for recreational opportunities.	Define how the land should be used either passive or active recreation (check POM)									15	15.75
75	Combine rehabilitation works by Aboriginal green teams with the opportunity to undertake an <i>Aboriginal Assessments</i> on private and other lands	Develop Protocols for rehabilitation works by green teams, Landcare etc. Aboriginal Assessments need to be undertaken by Elders. These are two different issues									15	14.7
76	Support Smart Farming initiatives.										15	14.7
77	Review catchment population/development based on the assessment of estuary carrying capacity and ecological assessments	Pending finalisation of CZMP									15	14.7

Ref ID	Option	If so, please indicate where? If not, please indicate where the option could or should we implemented?	No Regrets?	Degree of threat addressed	Risk Reduction Potential	Timeframe	Cost	Practicality	Community Support	Certainty of Outcome	Equal Weighted Score	Weighted Score
78	Update LEP zonings to reflect the limits to population growth and development (as based on the findings of land capability and ecological assessments) and to protect significant habitats requiring protection (as based on ecological assessments)	Pending finalisation of CZMP									15	14.7
79	Water quality monitoring for public recreation, including publicising results	Monitoring as part of EPA licence for treatment plants only. No other monitoring is conducted.									14	14
80	Educate and encourage residents to plant reeds and rushes on shoreline so does not detract from their view.	Planting should be conducted in the riparian zone and ongoing education to facilitate planting required									14	12.95
	Increase fines for dumping / pollution	Fines legislated under POEO Act									14	12.95
	Increase fines for dumping / pollution	The fines are controlled by the POEO Act									12	12.6
81	Provision of access points, toilets and facilities for passive boating away from powerboat ramps.	Jetty and facilities at Hannah Park North Richmond and facilities at Macquarie Park Windsor with jetty to be provided. Settlers Road Wisemans Ferry ramp requires upgrade.									12	13.65

Appendix B Generic Environmentally Friendly Seawalls Brochure



A seawall created at Bobbin Head, Hawkesbury River estuary, which has a gentle slope and a variety of habitats including pool areas.



A seawall at McMahons Point, Sydney Harbour, with pools built into the wall for added habitat.

How to make your Seawall more environmentally friendly



Are you planning to build a new seawall or to upgrade an existing one along an estuary foreshore?

Find out how you can design your seawall to reduce erosion while improving its value to plant and animal life.

Your seawall could be fish habitat!

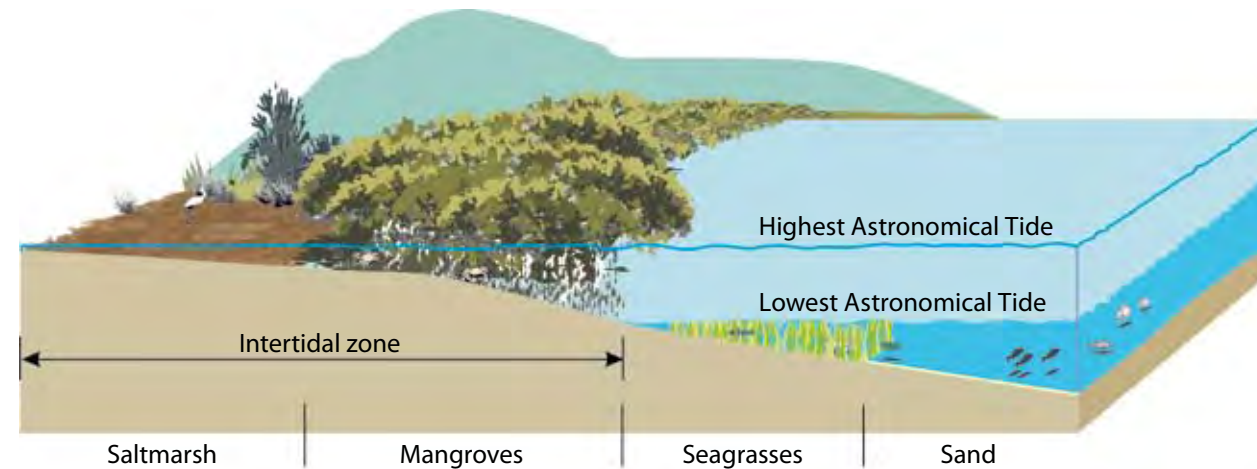


Impacts of seawalls

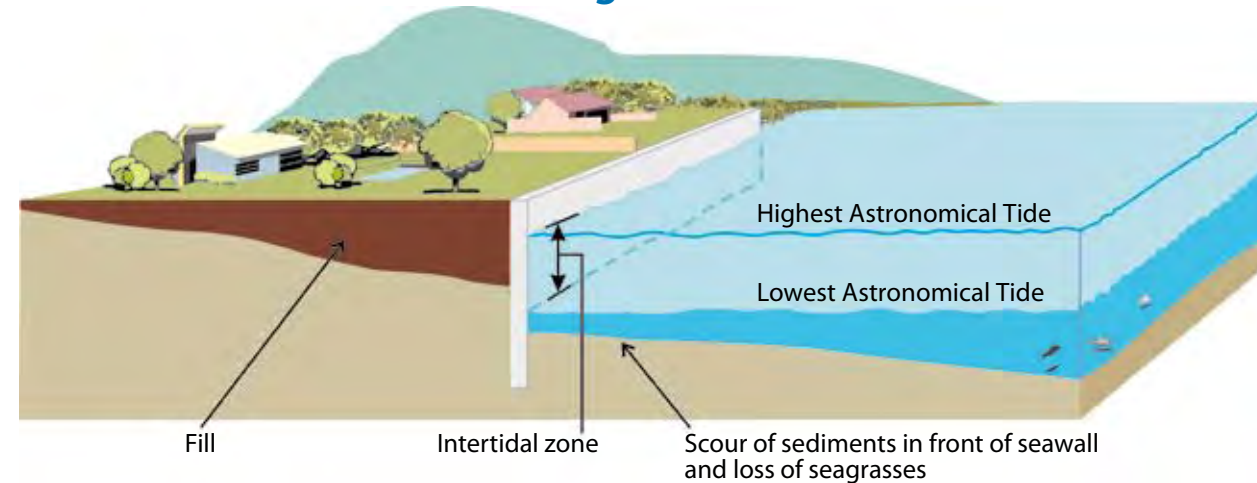
When seawalls are built using traditional methods, they typically result in damage to or loss of important habitats such as saltmarsh, mangroves and seagrass beds. These habitats are vital to many animals, such as fish and shorebirds, providing food and shelter. Seawalls are also poor replacements for natural foreshores because:

- the types of habitat and area available to plant and animal life are reduced dramatically (see diagrams below)
- the ability to filter pollutants from runoff is lost, leading to poorer water quality
- they can change flow and wave patterns, resulting in deepening in front of the seawall and erosion further along the shore.

Natural intertidal foreshore



Intertidal foreshore after building a seawall



Do you even need a seawall?

If you have an eroding bank, start by investigating 'softer' options to stabilise it. These can include the use of native foreshore and estuarine vegetation, with or without temporary structures to protect it during establishment.

As an example, use temporary wave barriers and estuarine vegetation such as mangroves to stabilise the shore. The wave barriers provide a protected area for mangroves or other suitable species to grow. When the mangroves are established, they protect the bank from waves and currents that cause erosion. Temporary fencing can then be removed. Native foreshore vegetation planted on the bank provides further bank stabilisation.



Mangrove seedlings planted in front of an eroding bank along the Shoalhaven River, with the use of temporary mesh fencing as a wave barrier. *Photo: Allan Lugg, Department of Primary Industries.*

Before you begin

Consider your options and seek advice

Design options required to create an environmentally friendly seawall will vary from site to site and will require a combination of site-specific approaches. Always seek professional advice from government agencies and environmental engineering consultants to determine which option is best for your situation, or whether other options besides a seawall would be more appropriate.

Get approval to build

Approval to build or upgrade a seawall will be required from your local council and relevant government agencies. Contact your local council in the first instance.

Access more information

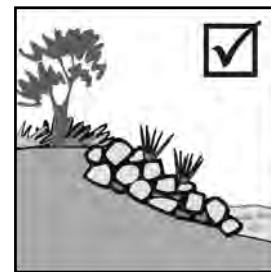
A detailed guideline on Environmentally Friendly Seawalls can be obtained by contacting the Sydney Metropolitan Catchment Management Authority (Ph: 9895 7898) or the Department of Environment and Climate Change NSW (Ph: 131 555).

Environmentally friendly seawall design principles

If a seawall is necessary, the design must always aim to protect and enhance habitats while minimising disruption to natural processes. Always consider using natural materials such as rock before concrete. Other key principles to design seawalls to more closely copy natural foreshores include:

Principle 1 Maximise the use of native foreshore and estuarine vegetation

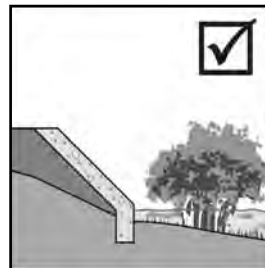
Include estuarine vegetation such as saltmarsh in the seawall



Plant native foreshore vegetation behind the seawall and in the gaps of rock seawalls

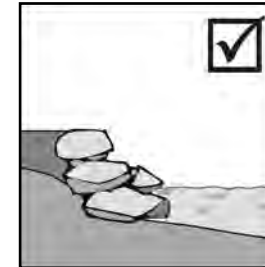


Establish mangroves in front of the seawall

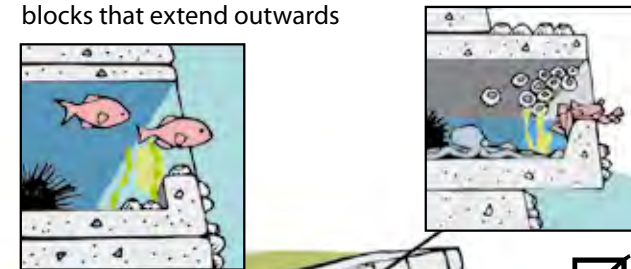


Principle 2 Maximise habitat diversity and complexity

Create walls of boulders of varying sizes and shapes, or irregularly shaped and weathered blocks

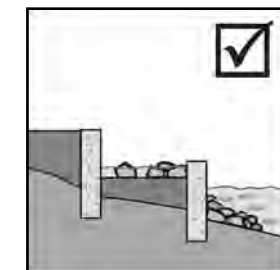
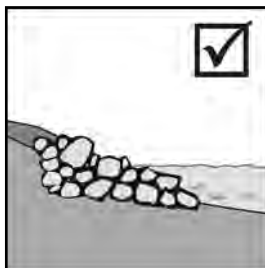


Include pool or crevice areas that retain water at low tide, and create seawalls with blocks that extend outwards



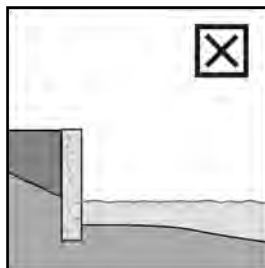
Principle 3 Create low-sloping seawalls or include changes of slope

Build the seawall with a gentle slope using boulders



Use benches or steps to break up and vary the slope

Do not build vertical seawalls



Appendix C Legislative requirements

Current requirements for Coastal Zone Management Plans (CZMPs) are set out in Part 4A of the *Coastal Protection Act 1979* and the supporting *Guidelines for Preparing Coastal Zone Management Plans* (OEH 2013) (the CZMP guidelines).

The minimum requirements for the preparation of CZMPs have been satisfied by this Upper Hawkesbury River Estuary Coastal Zone Management Plan as outlined in Table C1.

Table C1 – Minimum Requirements for preparing CZMPs

Requirement	Addressed in the Upper Hawkesbury River Estuary CZMP
CZMP Minimum Requirements	
A description of how the relevant Coastal Management Principles have been considered in preparing the plan	Refer to Table 1-1
A description of the community and stakeholder consultation process, the key issues raised and how they have been considered	As described in Section 1, Community Consultation is outlined in detail in a separate report. Consultation includes 3 community meetings, a stakeholder workshop, a web presence and community survey. Issues are summarised in Section 1.6 and described in more detail in BMT WBM 2013c. The process for prioritising actions to address the issues is described in Section 2
A description of how the proposed management options were identified, the process followed to evaluate management options, and the outcomes of the process	Refer to Section 2.1
Proposed management actions over the CZMP's implementation period in a prioritised implementation schedule which contains: <ul style="list-style-type: none"> • proposed funding arrangements for all actions, including any private sector funding • actions to be implemented through other statutory plans and processes • actions to be carried out by a public authority or relating to land or other assets it owns or manages, where the authority has agreed to these actions (section 55C(2)(b) of the <i>Coastal Protection Act 1979</i>). 	Refer to Section 3 and Section 4

Requirement	Addressed in the Upper Hawkesbury River Estuary CZMP
<ul style="list-style-type: none"> proposed actions to monitor and report to the community on the plan's implementation, and a review timetable 	
<p>Prepared using a process that includes:</p> <ul style="list-style-type: none"> evaluating potential management options by considering social, economic and environmental factors, to identify realistic and affordable actions consulting with the local community and other relevant stakeholders. The minimum consultation requirement is to publicly exhibit a draft plan for not less than 21 days, with notice of the exhibition arrangements included in a local newspaper (section 55E of the <i>Coastal Protection Act 1979</i>) considering all submissions made during the consultation period. The draft plan may be amended as a result of these submissions (section 55F of the <i>Coastal Protection Act 1979</i>). 	<p>Refer to Sections 1 and 2 and BMT WBM 2013c.</p>
<p>CZMPs are to achieve a reasonable balance between any potentially conflicting uses of the coastal zone</p>	<p>This CZMP has sought to manage all high priority risks to the Upper Hawkesbury River Estuary with a key focus on a balance between environmental, social and economic values. This has been achieved through adopting a risk based approach, where consequence is defined in terms of social, economic and environmental outcomes and by using a multicriteria assessment as outlined in Section 2.1</p>

Other requirements requested to be addressed by OEHL in regard to a CZMP that addresses coastal ecosystem management are presented in Table C-2.

Table C-2 OEH Requirements

Requirement	Comment
A description of the health status of the estuary within the plan's area	This was addressed in the Upper Hawkesbury River Estuary Synthesis Report.
the pressures affecting estuary health status and their relative magnitude	This was addressed in detail in the Upper Hawkesbury River Estuary Synthesis Report and Community Consultation Report. This information is summarised in Section 1.6 of the present document
Projected climate change impacts on estuary health (section 55C(f) of the <i>Coastal Protection Act 1979</i>). This is to include incorporation of the sea level rise benchmarks from the NSW Sea Level Rise Policy Statement 2009	This was addressed in the Upper Hawkesbury River Estuary Synthesis Report and Community Consultation Report. Sea level rise impacts are summarised in Section 1.6.6 of the present report
proposed actions in the implementation schedule to respond to estuary health pressures (section 55C(e) of the <i>Coastal Protection Act 1979</i>)	Please refer to Section 3
an entrance management policy for intermittently closed and open lakes and lagoons (ICOLLs)	Not applicable
an estuarine monitoring program, consistent with the NSW Natural Resources Monitoring, Evaluation and Reporting (MER) Strategy.	Please refer to Section 4
proposed actions in the implementation schedule that protect and preserve beach environments and beach amenity, and ensure continuing and undiminished public access to beaches, headlands and waterways, particularly where public access is threatened or affected by accretion (section 55C(c) of the <i>Coastal Protection Act 1979</i>)	Please refer to Section 3 and in particular the Recreation and Amenity Sub-Plan in Section 3.3
a description of: <ul style="list-style-type: none"> the current access arrangements to beaches, headlands and waterways in the plan's area, their adequacy and any associated environmental impacts any potential impacts (e.g. erosion, accretion or inundation) on these access arrangements, and the cultural and heritage significance of the plan's area 	These are mapped in the Synthesis Report and the Community Consultation Report.

Requirement	Comment
proposed actions in the implementation schedule to manage any environmental or safety impacts from current access arrangements, and to protect or promote the culture and heritage environment.	Please refer to Section 3



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