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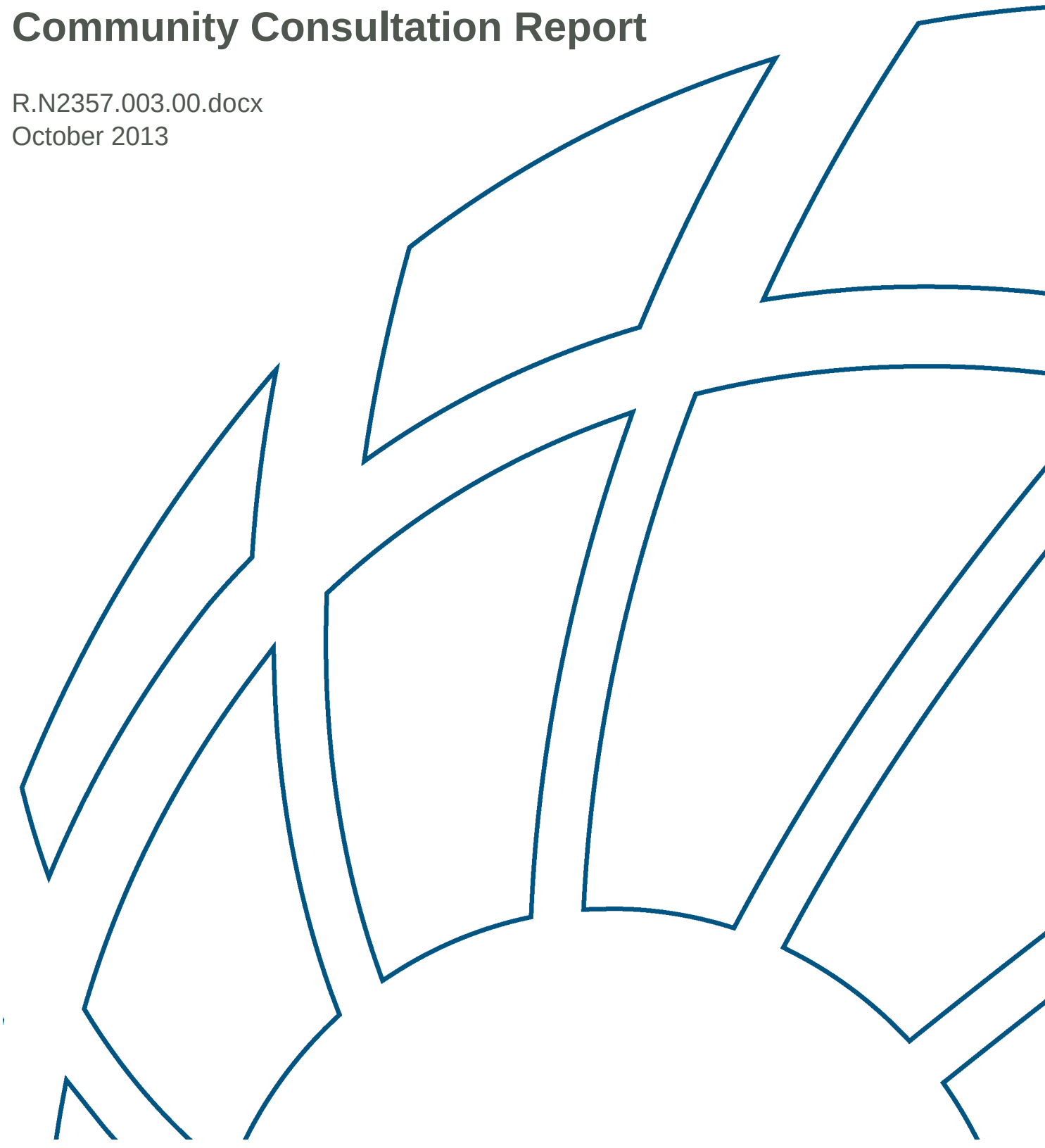
Upper Hawkesbury River Estuary: Community Consultation Report

R.N2357.003.00.docx
October 2013



Upper Hawkesbury River Estuary: Community Consultation Report

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Document:	R.N2357.003.00.docx
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Client Reference:	

Synopsis: **This report summarises the outcome of initial community and stakeholder consultation regarding the Upper Hawkesbury River Estuary.**

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by		Issued by	
0	22/10/2013	PH		MF	

DISTRIBUTION

Destination	Revision										
	0	1	2	3	4	5	6	7	8	9	10
Hawkesbury Shire Council	PDF										
BMT WBM File	PDF										
BMT WBM Library	PDF										

Executive Summary

This report documents the outcomes of community and stakeholder consultation undertaken to assist in the development of the Upper Hawkesbury River Coastal Zone Management Plan (CZMP). The consultation activities include:

- A Community drop in information booth for the day on the 29th June 2013;
- An open community meeting on 15th July 2013;
- A website including online surveys;
- A targeted stakeholder workshop including participants form relevant government agencies and industry; and
- A meeting and telephone based discussions with representatives of the local aboriginal community.

Given the size, significance, and interest in the study area, it is not surprising that a very long list of issues has been compiled. All issues raised are included in either the main body or appendix of this report.

The list has been condensed into a shortlist of 11 target threats, which will be the focus of the CZMP. These include:

(1) Riparian land uses;

(2) Water based development;

(3) Catchment land use;;

(4) Weed invasion in riparian areas;

(5) Illegal dumping of waste along the estuary;

(6) Sea level rise;

(7) Sediment supply;

(8) Boat based activities;

(9) Private ownership of foreshore land;

(10) Sewage treatment plant discharges; and

(11) Water extraction and dams.

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1 Introduction

This report is the second in a series of reports being prepared by BMT WBM for Hawkesbury City Council and the NSW Office of Environment and Heritage that support the overall preparation of a Coastal Zone Management Plan (CZMP) for the Upper Hawkesbury River Estuary.

The Upper Hawkesbury River Estuary CZMP will provide a list of actions and related implementation details to be carried out by Hawkesbury City Council (Council), other public authorities and potentially the community to address priority management issues affecting the Upper Hawkesbury River Estuary over a defined implementation period. As the CZMP will guide the investment of resources in the estuary, it needs to be based on the best possible information.

The project has been divided into three distinct stages as shown in Table 1-1.

Table 1-1 Stages Involved in the Preparation of the Upper Hawkesbury River Estuary CZMP

Stage 1	Stage 2	Stage 3
Outcome: Synthesis Report	**Outcome: Short-list of Management Options**	**Outcome: CZMP Action Plan**
Involves: collation and detailed review of existing background information and stakeholder consultation regarding the Hawkesbury River and its existing governance framework and management initiatives	Involves: community involvement to identify values, community uses and pressures/threats to the river. Risk assessment to prioritise goals and objectives for management before formulating and assessing potential management options	Involves: development of the CZMP document, including implementation schedules. This stage also involves further consultation with agencies regarding co-operation for implementation as well as potential funding for works and measures

1.1 Study Area

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 will need to include 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 receiving waters of the river. In this regard, the relevant catchment therefore incorporates the catchments of the

Colo and Grose Rivers, as well as the entire Nepean River catchment that extends as far south as Goulburn and as far west as Lithgow.

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 (2007) 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.

1.2 Management by Reaches

For the purpose of management planning, the study area will be 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).
- Windsor to Sackville (see Figure 1-2).
- Sackville to Wisemans Ferry (see Figure 1-3).
- The Colo River (see Figure 1-4).
- The floodplain lagoons (see Figure 1-5).

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

1.2.1 Yarramundi to Windsor

The Yarramundi to Windsor Reach is wide and shallow with moderate freshwater 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 low in this reach, possibly due to uptake by the prolific aquatic weed *Egeria densa*.

1.2.2 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 rare.

1.2.3 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. The eastern foreshores are in Hawkesbury LGA and the western foreshores are in the Hills LGA.

1.2.4 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 having a status of “wild river” further upstream. Webbs Creek experiences some erosion and weed invasion in the downstream reached, 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.

1.2.5 The Floodplain Lagoons

The 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 stocked with carp at present, they have some potential for native fish habitat.

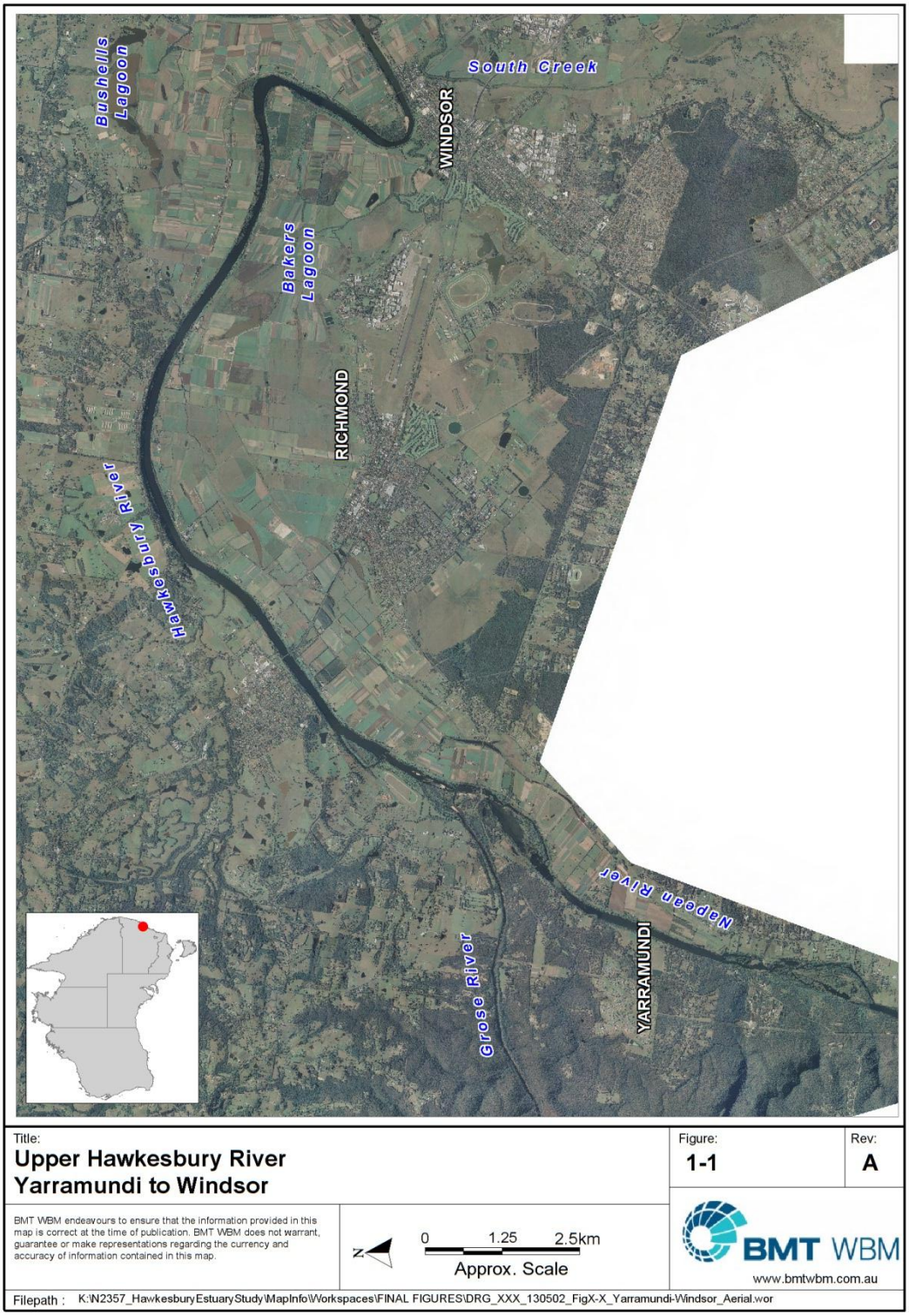


Figure 1-1 Yarramundi to Windsor Reach

Figure 1-2 Windsor to Sackville Reach

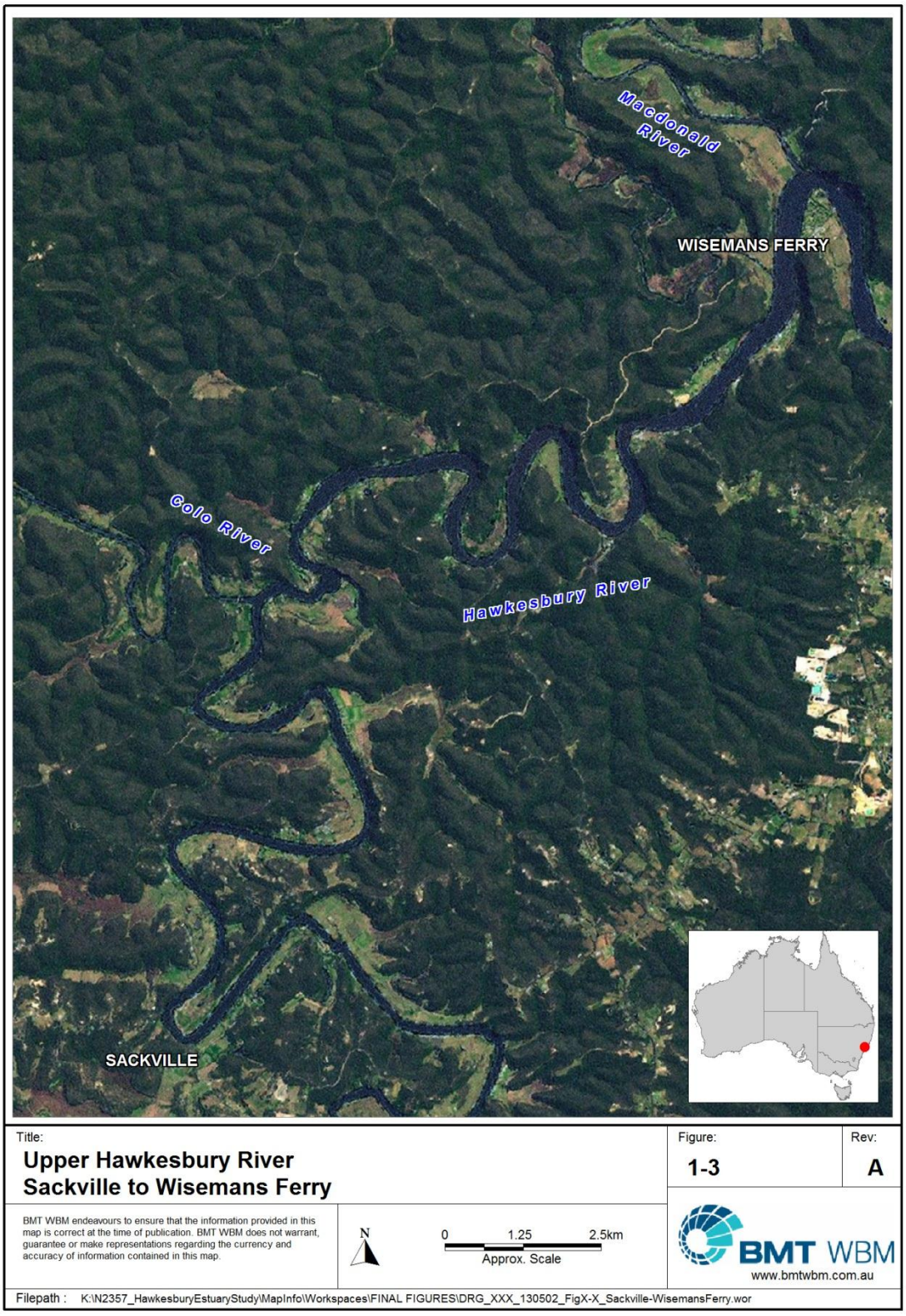


Figure 1-3 Sackville to Wisemans Ferry Reach

Figure 1-4 Colo River Reach

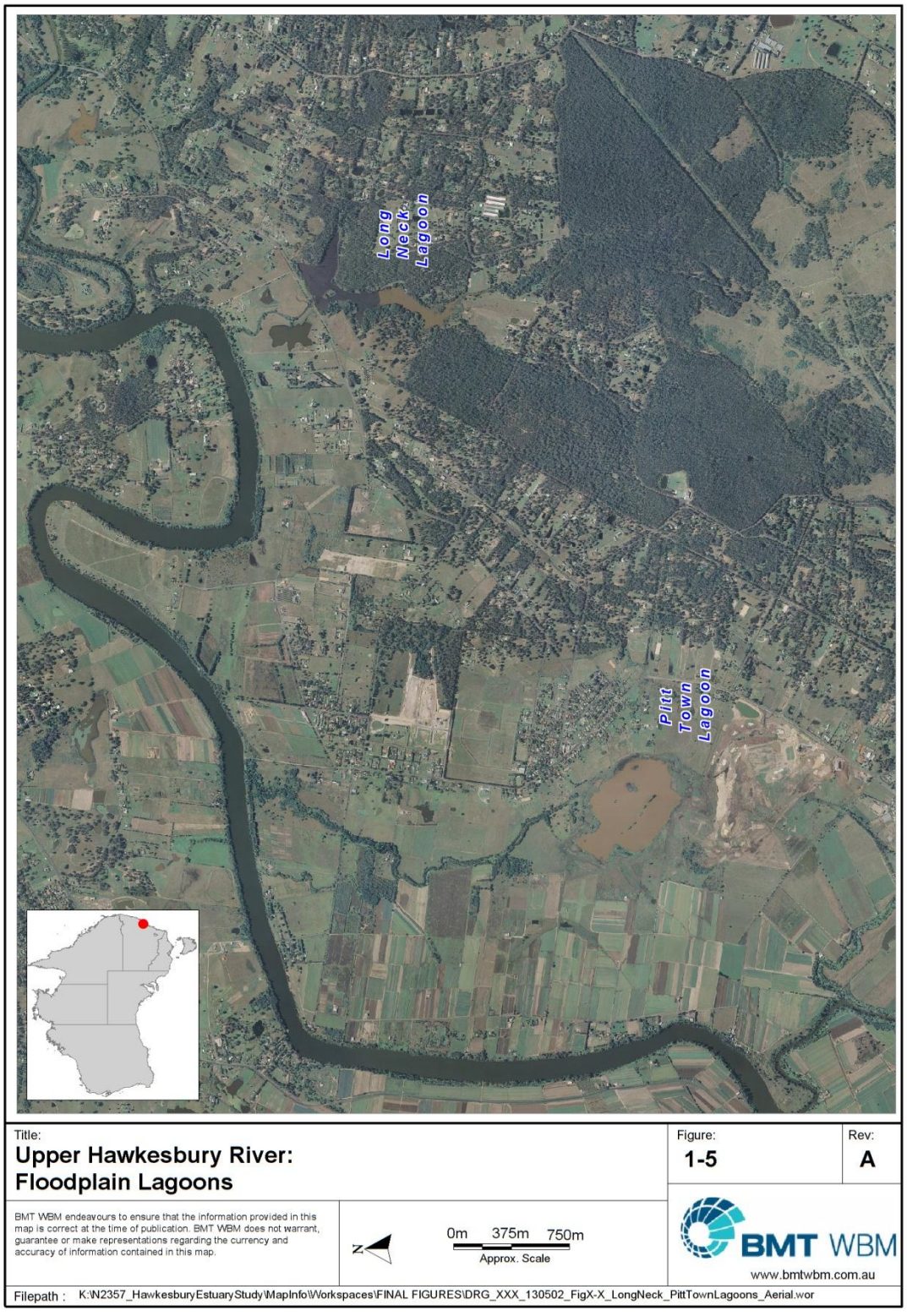


Figure 1-5 Floodplain Lagoons

2 Consultation Activities

The consultation program involved a number of activities in an attempt to capture the ideas and knowledge of a broad base of individuals. Each of these consultation activities is discussed within this chapter, while the issues, pressures and threats are described in chapter 3.

2.1 Consultation during the Background Review

At the initiation of this study, relevant stakeholders were contacted by letter. This first round of consultation was reported on in the Upper Hawkesbury River Estuary Synthesis Report (BMT WBM, 2013). Within the conclusion of the Synthesis Report, a first pass list of issues to be addressed in the CZMP was suggested. This list was used as a starting point for further the community and stakeholder consultation, which aimed to establish a deeper understanding of the key issues and to prioritise the issues to be addressed by the CZMP.

Table 2-1 First Pass List of Pressures and Issues Based on the Background Review

Pressure	Issues
Riparian Land Uses	Lack of appropriate riparian vegetation (and deliberate clearing to increase views) Approx. 27 caravan parks, associated works and Impacts Ad-hoc bank works Use of fertilisers and pesticides Clearing in riparian areas despite SEPP (previously SREP 20), LEP and Tree Preservation Orders Encroachment of private development onto public land (e.g. Holmes Drive Reserve).
Water Based Development (jetties, stairs, bank protection works etc.)	Contribution to bank degradation and loss of riparian vegetation Visual impacts Barriers to fish passage
Catchment Development	Urbanisation Mining within the catchment
Weed invasion in riparian areas	Destabilised banks Erosion Clearing of native vegetation and planting inappropriate species Recent appearance of *Arundo donax* Lack of central mapping Private ownership Impacts of dam overflows for weed proliferation
Introduced fauna	Changed hydrological regime favours introduced fish species (e.g. carp)
Climate change / sea level rise	Further propagation of tide / impacts on ecology Impacts to mangroves and casuarina forests in Webbs Creek Increased frequency of extreme events Exacerbating impacts from reduced environmental flows
Illegal dumping of	Fill, crushed rock and other ad hoc waste materials etc. along riparian

Pressure	Issues
waste along the estuary	zone Rubbish from recreational users
STP discharges	South Creek with major STP inputs Contribution to proliferation of algae blooms / aquatic weeds Impacts on aquatic ecology Impacts of medication derived chemicals in human waste on aquatic organisms (e.g. hormones) Impacts to recreational users
Private ownership of foreshore lands	Limited access Poor condition of riparian lands Interruption to riparian corridors Encroachment of private development onto the limited areas of public land (e.g. Holmes Drive Reserve).
Boat based activities (includes commercial, agricultural and recreational)	Wake boarding and water skiing contributing to bank erosion Carrying capacity of estuary Increased number of boats Shift to wake boarding Appropriateness of recreational zones Effluent disposal
Water extraction and dams	Abstraction licences Domestic water Pumps as a barrier to fish passage Impacts to flow regime Stormwater not included in environmental flows considerations (role of freshwater in flushing nutrients not considered) Impacts on stratification Extractor not paying true environmental cost
Agricultural inputs	Contribution to algal proliferation Water demand Use of fertilisers, manure etc. Impact of farm dams
Fishing	Impacts of prawn trawling Impacts of eel catchers Unknown catch from recreational fishers
Siltation	Impacts on navigation Smothering of vegetation Proliferation of mangroves
Management approach	Lack of action on obvious issues Fragmentation of authority and approach Impact of government cycle (funding and policy changes) Need for consistent objectives and integrated panning to meet these No single authority looking at cumulative impacts Lack of compliance activities

2.2 All Day Information Booth – June 29th 2013

A desk was set up and staffed by Suzanne Stuart of Hawkesbury Council and Michelle Fletcher from BMT WBM in Richmond Square. The opportunity to discuss the study area, any specific issues and any ideas for future management was available to passers-by from 9am until 4pm on a Saturday. The Stall was busy for most of the day with an estimated visitation number of 40 people. Some had come in response to the newspaper advertising and others were opportunistic.

A list of issues raised and opinions expressed is included as Appendix A.

2.3 Community Meeting – July 15th 2013

A community meeting was held at the Windsor Library building with 32 registered attendees.

The community meeting involved a brief presentation and project background followed by two activities. A compilation of written comments from the group activities undertaken at the meeting is included as Appendix B. Key information is summarised in Table 2-2 and Table 2-3.

The first activity focussed on establishing what attendees valued about the Upper Hawkesbury River Estuary. The second activity involved focussing in on the most highly rated values and identifying the processes threatening the values, based on individual participants experience and knowledge of the system,.

Table 2-2 Summary of Comments on Values from the Community Meeting

Value	Summary of Comments
Natural bushland / riparian vegetation	Although present, it is quite degraded, but important for protecting against erosion and water quality
View aesthetic beauty	Need for balance between views to the waterway, and appearance of natural bank vegetation
Access to waterway	Access is highly valued. It is very limited and increases in access would be appreciated.
Presence of threatened species	Improvements to overall water quality, riparian vegetation would improve habitat values.
Recreational opportunities	More places to picnic etc, would be appreciated, some concern regarding too many speed boats
Water uality	Underpins most other values, South Creek and Cattai Creek identified as sources of poor water quality
Heritage / cultural values	High value from Aboriginal perspective, although more information needed, high value from European perspective
Tourism potential	Potential not fully realised.
Fish habitat values	Linked to water quality and riparian vegetation- important priority
Water bird habitat	Linked to riparian vegetation.

Table 2-3 Summary of threats to selected priority values from the community meeting

Value	What threatens this value?
Views/ aesthetic beauty	Two perspectives – some feel trees block views, some feel removal or trees ruins view.
Commercial fishing	Pollution inputs, catchment development, weeds, removal of aquatic vegetation
River bank quality	Uncertainty about permissible/appropriate protection works, cattle access
Water quality	Reduced environmental flows, agricultural runoff, South Creek (industrial pollution), Cattai Creek (urban development), urban stormwater, STP discharges
Agriculture	Water quality declining
Tourism potential	Lack of facilities, declining water quality, lack of public land

The last activity of the workshop involved an open ended question about options to manage the threats and protect the values. All options listed during this activity will be considered in the management plan. These options are listed in the raw data included in Appendix B and also the options long list included in Appendix C.

The meeting also offered the opportunity for one on one discussion with study team members.

2.4 Stakeholder Workshop August 2013

A stakeholder workshop was held for invited representatives in August 2013. Invitees included representatives from the following organisations:

(to be added)

The workshop started with an introduction and overview of background information. The group then worked through three different activities, with breakout groups of 4-5 attendees focussing on each of the five reaches.

The raw information obtained from the workshops is included in Appendix C.

2.4.1 Values Assessment

The first activity was a values assessment. This was a refinement of the work undertaken through the community meeting. While the community meeting focussed on the study area as a whole, the stakeholder workshop was divided into focus groups to concentrate on each of the five reaches.

The second activity assessed the values further by considering their present condition (using a scale of Acceptable, Approaching Intolerable and Intolerable). Starting with a first pass list of indicators for the condition of each of these parameters, each of the break out groups were asked to identify appropriate indicators. The focus was on 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; and
- Are easy/ cost effective to measure.

The starting point for indicators presented to the group is shown in Table 2-4

Table 2-4 First Pass Matrix of Indicators for Key Values of the Upper Hawkesbury River Estuary

VALUES	Bank erosion foreshore length	Minimum dissolved oxygen concentration	Salinity	Flow rates	Depth	Faecal indicator	Number of new non complying structures	% foreshore in private ownership	macroinvertebrates	Bass catches	Riparian buffer width	Algal blooms	Egeria densa	Fish Surveys	Fledglings
Water Views												X	X		
Recreational Opportunities / Tourism	X				X	X		X				X			
Heritage / cultural values	X							X							
Water source for agricultural businesses			X	X								X			
Transportation (ferries)					X										
Commercial fishing		X								X	X	X			
Natural Bushland / riparian vegetation	X						X				X				
Presence of threatened species		X		X					X			X		X	
Fish habitat values	X	X					X			X	X	X		X	
Water bird Habitat									X						X

Coming out of the stakeholder workshops are the following Tables which describe the values, their condition and possible indicators for each of the reaches. As with all of the information coming out of the consultation activities, they are subjective and based on the knowledge, experience and interests of the attendees. Within the final CZMP an Estuary Health Monitoring Program will be described. The indicators suggested here will feed into the design of that monitoring program.

Table 2-5 Values, Condition Assessment and Suggested Indicators (Yarramundi to Windsor)

Value	Workshop Group Condition Assessment			Indicators												
	Acceptable	Approaching Intolerability	Intolerable	Bank erosion foreshore length	Minimum DO	Riparian Veg width	#new non complying structures	Salinity	Depth	Eel/ Bass catches	Weeds	Algal Blooms	Faecal Indicator	Biodiversity Surveys	Waterbird Surveys	Environmental Flows
Water Views		X		X		X						X				
Recreational Opportunities - Passive		X				X							X			
Recreational Opportunities - Active									X							
Heritage/Cultural Values		X														
Water Source for Ag.		X→						X								X
Commercial Fishing (Eel)		X→			X											
Natural bushland/Riparian Veg		X		X		X								X		
Presence of threatened species	?	?	?											X	X	
Fish Habitat	?	?	?							X				X		
Water Bird Habitat		X												X	X	

Table 2-6 Values, Condition Assessment and Suggested Indicators (Windsor to Sackville)

Value	Workshop Group Condition Assessment			Indicators												
	Acceptable	Approaching Intolerability	Intolerable	Bank erosion foreshore length	Minimum DO	Riparian Veg width	#new non complying structures	Salinity	Depth	Eel / Bass catches	Weeds	Algal Blooms	Faecal Indicator	Biodiversity Surveys	Water bird Surveys	Environmental Flows
Water Views		X		X			X				X	X				
Recreational Opportunities		X→		X					X			X	X			
Heritage/Cultural Values	X															
Water Source for Ag.	X							X				X				X
Transportation (Ferries)	X								X							
Commercial Fishing (Eels)	X															
Natural bushland/Riparian Veg		X→		X		X	X				X			X		
Presence of threatened species	?	?	?											X	?	
Fish Habitat	?	?	?	X	X	X				?						
Water Bird Habitat	?	?	?											X	X	

Table 2-7 Values, Consensus Condition Assessment and Suggested Indicators (Colo River)

Value	Workshop Group Condition Assessment			Indicators												
	Acceptable	Approaching Intolerability	Intolerable	Bank erosion foreshore length	Minimum DO	Riparian Veg width	#new non complying structures	Salinity	Depth	Bass catches	Weeds	Algal Blooms	Faecal Indicator	Biodiversity Surveys	Water bird Surveys	Environmental Flows
Water Views	X					X										
Recreational Opportunities	X												X			
Heritage/Cultural Values	X			X		X										
Water Source for Ag.	X							X								X
Commercial Fishing	X			X	X	X				X						X
Natural bushland/Riparian Veg	X					X				X				X		
Presence of threatened species	X													X		
Fish Habitat	X					X				X						
Water Bird Habitat	X													X	X	
Groundwater	X															

Table 2-8 Values, Consensus Condition Assessment and Suggested Indicators (Sackville to Wisemans Ferry)

Value	Workshop Group Condition Assessment			Indicators													
	Acceptable	Approaching Intolerability	Intolerable	Bank erosion foreshore length	Minimum DO	Riparian Veg width	#new non complying structures	Salinity	Depth	Prawn / Bass catches	Weeds	Algal Blooms	Faecal Indicator	Biodiversity surveys	Water bird Surveys	Environmental Flows	Noise
Water Views		X		X			X										
Recreational Opportunities		X		X									X				X
Heritage/Cultural Values	X													X			
Water Source for Ag.	X							X								X	
Transportation (Ferries)	X								X								
Commercial Fishing (Bass, prawns)					X					X						X	
Natural bushland/Riparian Veg		X		X		X					X			X			
Presence of threatened species	?	?	?											X			
Fish Habitat	X				X	X	X			X				X		X	
Water Bird Habitat	?	?	?											? X	X		

Table 2-9 Values, Consensus Condition Assessment and Suggested Indicators (Floodplain Lagoons)

Value	Workshop Group Condition Assessment			Indicators													
	Acceptable	Approaching Intolerability	Intolerable	Bank erosion foreshore length	Minimum DO	Riparian Veg width	#new non complying structures	Salinity	Depth	Prawn / Bass catches	Weeds	Algal Blooms	Faecal Indicator	Biodiversity Surveys	Water bird Surveys	Environmental Flows	Noise
Water Views		X ←					X				X	X					
Recreational Opportunities		X					X					X	X				
Heritage/Cultural Values	?	?	?														
Water Source for Ag.		X						X									
Natural bushland/Riparian Veg		X		X							X						
Presence of threatened species		X				X								X	X		
Fish Habitat		X					X				X	X		X			
Water Bird Habitat	X →													X	X		

2.4.2 Threat Assessment

The third activity of the stakeholder workshop was assessing the threats for each of the reaches and prioritising these threats. This exercise adopted a risk management approach.

A risk-based framework is a robust methodology for dealing with outcomes that are uncertain or have limited data, or for impacts with uncertain timeframes. A key step towards improving, protecting or maintaining the estuary values is identifying the risks that may threaten those values. The use of a risk-based approach for managing coastal hazards is a requirement of the new CZMP Guidelines, and accords with current international best practice for natural resource management.

The standard risk management approach defines the magnitude of risk as a combination of 1) the likelihood of a risk event occurring, and 2) the consequence if such an event does occur. For this

project, a variation on the standard risk approach has been adopted to address management of existing threats that already have a 'frequency' of occurrence, as opposed to future / unrealised risks that have a 'likelihood' of occurrence. Essentially, a threat or risk assessment process is the same, only threats are described in terms of their frequency, compared with risks that are described in terms of their likelihood. In both cases, the consequence of the threats that have (or may) occur or of the risks that may occur forms the second variable in calculating the magnitude of the threat/risk.

Table 2-10 Threat Frequency Categories

Scale	Frequency Descriptor
1	Almost Never
2	Rare
3	Infrequent
4	Occasionally
5	Often / continuous

For this study, the threat consequence descriptors focussed on the condition and limit of acceptable change. Consequences were markedly different for the same threats on different reaches.

Table 2-11 Threat Consequence Descriptors

Scale	Consequence
1	Changes are minor /within natural variability
2	Approaching limit of acceptable change, recovery without intervention is still possible
3	At limit of acceptable change, recovery possible with intervention
4	Beyond limit of acceptable change, recovery is possible with further intervention but will take several years
5	Permanent Loss of Value; Unacceptable change to ecological character has occurred, recovery unlikley

Once the frequency and consequence values have been assigned, a threat level can be determined from the matrix.

Table 2-12 Threat Matrix

	Negligible (1)	Small but measurable (2)	Moderate (3)	Major (4)	Permanent (5)
Often / Continuous(5)	LOW	MEDIUM	HIGH	HIGH	EXTREME
Occasionally (4)	LOW	MEDIUM	HIGH	HIGH	HIGH
Infrequent (3)	LOW	MEDIUM	MEDIUM	HIGH	HIGH
Rare (2)	LOW	LOW	MEDIUM	MEDIUM	MEDIUM
Almost never (1)	LOW	LOW	MEDIUM	MEDIUM	MEDIUM

This process was applied to each of the threats for each of the reaches during the workshop. Chapter of this report included a summary of each of the target threats.

2.5 Understanding Aboriginal Cultural Heritage Values and Threats

Estuaries are meeting places for Aboriginal people. Before European arrival to mainland Australia, the Upper Hawkesbury River Estuary would have been an important place and resource for the Aboriginal people of the area. The Guidelines for preparing Coastal Zone Management Plans (NSW Government, 2010) require that a CZMP includes appropriate actions to protect and promote the cultural and heritage environment in the coastal zone. Items and places of cultural and spiritual significance within the coastal zone include shell middens, ceremonial grounds, rock art and artefacts.

2.5.1 Aboriginal People, the Environment and Conservation Principles (DEC 2008).

The Guidelines for Preparing Coastal Zone Management Plans (NSW Government, 2010) require adherence to the DEC document Aboriginal People, the Environment and Conservation Principles (DEC, 2008). The document needs to be read in full to appreciate its contents, however some key points relevant to the preparation of a CZMP include:

- In the Aboriginal world view, people and Country (including traditional lands and seas) are an integral whole and the entire landscape has spiritual significance;
- As the first people of Australia, Aboriginal people have inherent rights that were never given away including the right to self-determination and the right to maintain culture, language, knowledge and identity;
- Access to Country and its resources is essential so Aboriginal people can continue cultural practices, maintain links with the land and care for Country; and
- Aboriginal communities obtain cultural, social and economic benefits through being involved in environmental management and conservation.

2.5.2 Meeting with Local Representatives of the Aboriginal Community

It can be a challenge to know who the appropriate representatives of an Aboriginal Community are and to garner the range of possible views within a community. For the present project, consultation was undertaken with Stacy-Jane Etal, Acting Co-ordinator Merana Aboriginal Community Association for the Hawkesbury Inc. and also a meeting with Kevin and Robert L of the Deerubin Aboriginal Lands Council.

Deerubbin LALC (the LALC) has acquired portions of land within the catchment of the Upper Hawkesbury Estuary through the Aboriginal Land Rights Act. The LALC is committed to using the land to improving the social and economic status of its members and other Aboriginal persons in its area.

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. This includes six Conservation and Land Managers with harness training, which is required for weed removal tasks on steep banks. Some of the sites being worked on include in the vicinity of Morans Rock, the old Mission site, Wheeny Creek and Maroota. A big focus of this work is mechanical removal of Lantana.

In order to further the social and economic status of Aboriginal people in the area, the LALC also looks for opportunities for using and developing its lands to produce an income stream. Some mapping shows land owned by the LALC as publically owned land and this is not accurate.

Deerubbin LALC is also committed to working for the protection and promotion of Aboriginal culture and heritage in its area.

Mapping of identified Aboriginal sites is available through the Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management System (AHIMS) which includes:

- Information about Aboriginal objects that have been reported to the Director General, Department of Premier and Cabinet;
- Information about Aboriginal Places which have been declared by the Minister for the Environment to have special significance with respect to Aboriginal culture; and
- Archaeological reports.

During the meeting with the Deerubbin LALC, the available mapping was loaded in GIS and discussed. The mapping is heavily focussed on items identified by archaeologists and is somewhat inaccurate and incomplete. Much of the riverside land downstream of Yarramundi is privately owned and there are very few sites recorded in the 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.

Consideration will be given to including actions to protect and enhance the Aboriginal Cultural Heritage Values of the study area through the CZMP.

2.6 Spatial Mapping of Issues

A key outcome of the consultation is spatial mapping of issues documented by participants. During each of the consultation events, large hard copy maps were available for participants to provide locations and details for specific issues. This included for example, sites of sediment build up, stormwater devices such as Gross Pollutant Traps that were frequently overloaded, hot spots for erosion and weed invasion. This information source has been used extensively through the threat assessment and option development stage and will continue to feed into the Coastal Zone Management Plan. It will also be a useful benchmarking tool for assessing the success of the Coastal Zone Management Plan in the future.

In order to bring together a spatial overview of knowledge for each of the reaches, the issues mapping has been combined with mapping of key processes to give a quick mud map of the driving considerations for each reach. Considerable detail underpins each of these maps as documented in the Synthesis Report and detailed appendices shown here.

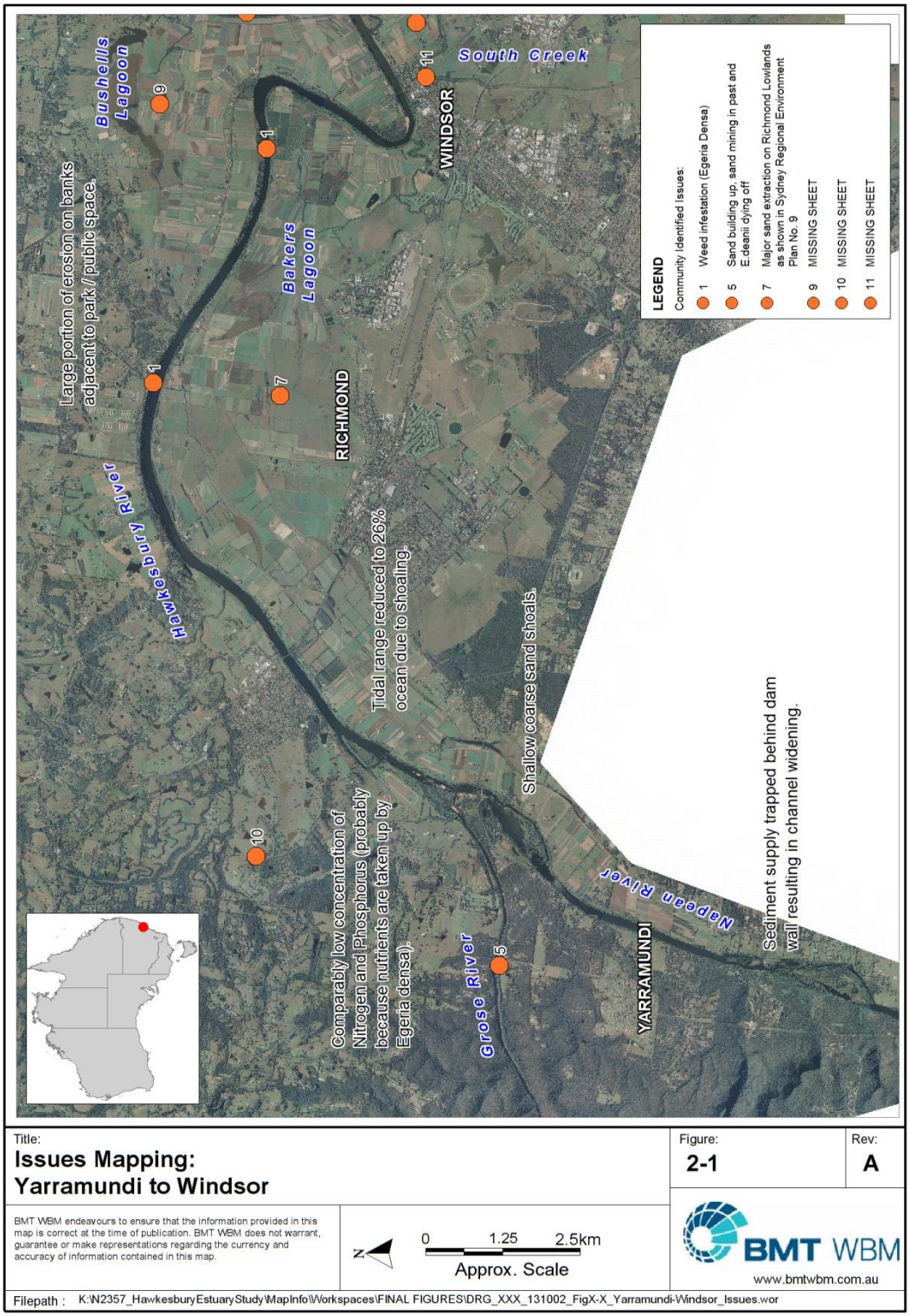


Figure 2-1 Issues Mapping from Consultation Yarramundi to Windsor

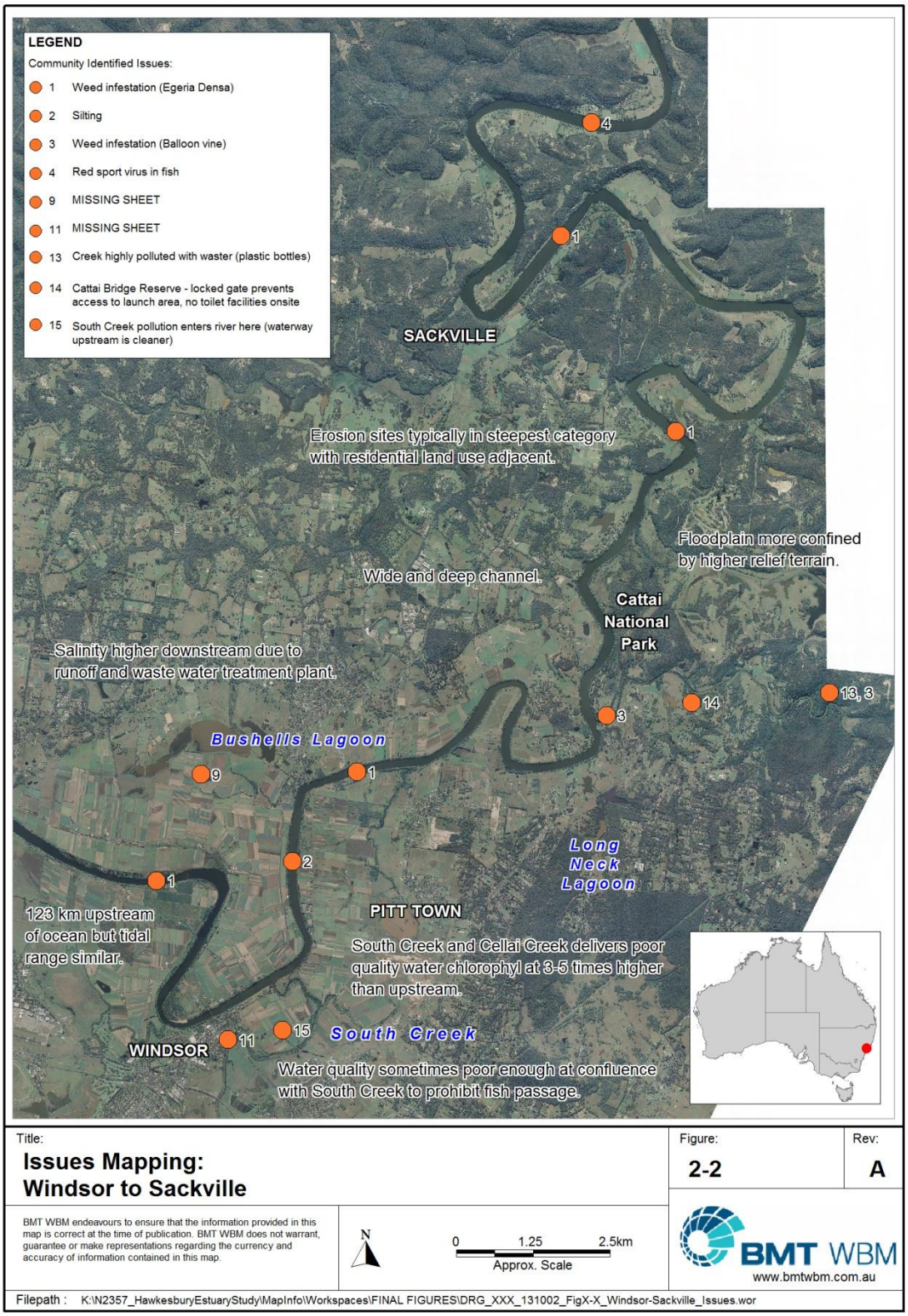


Figure 2-2 Issues Mapping from Consultation Windsor to Sackville

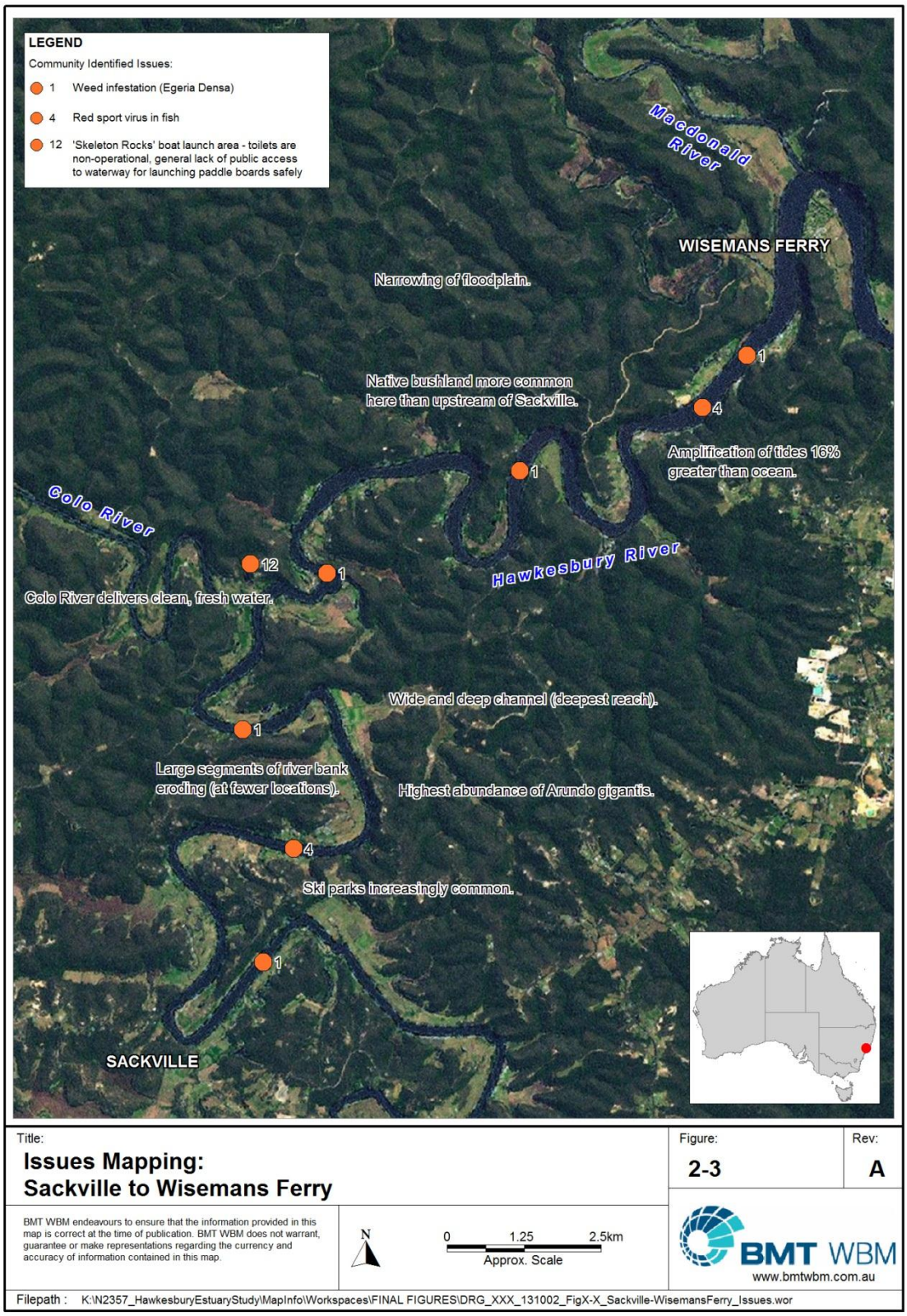


Figure 2-3 Issues Mapping from Consultation Sackville to Wisemans Ferry

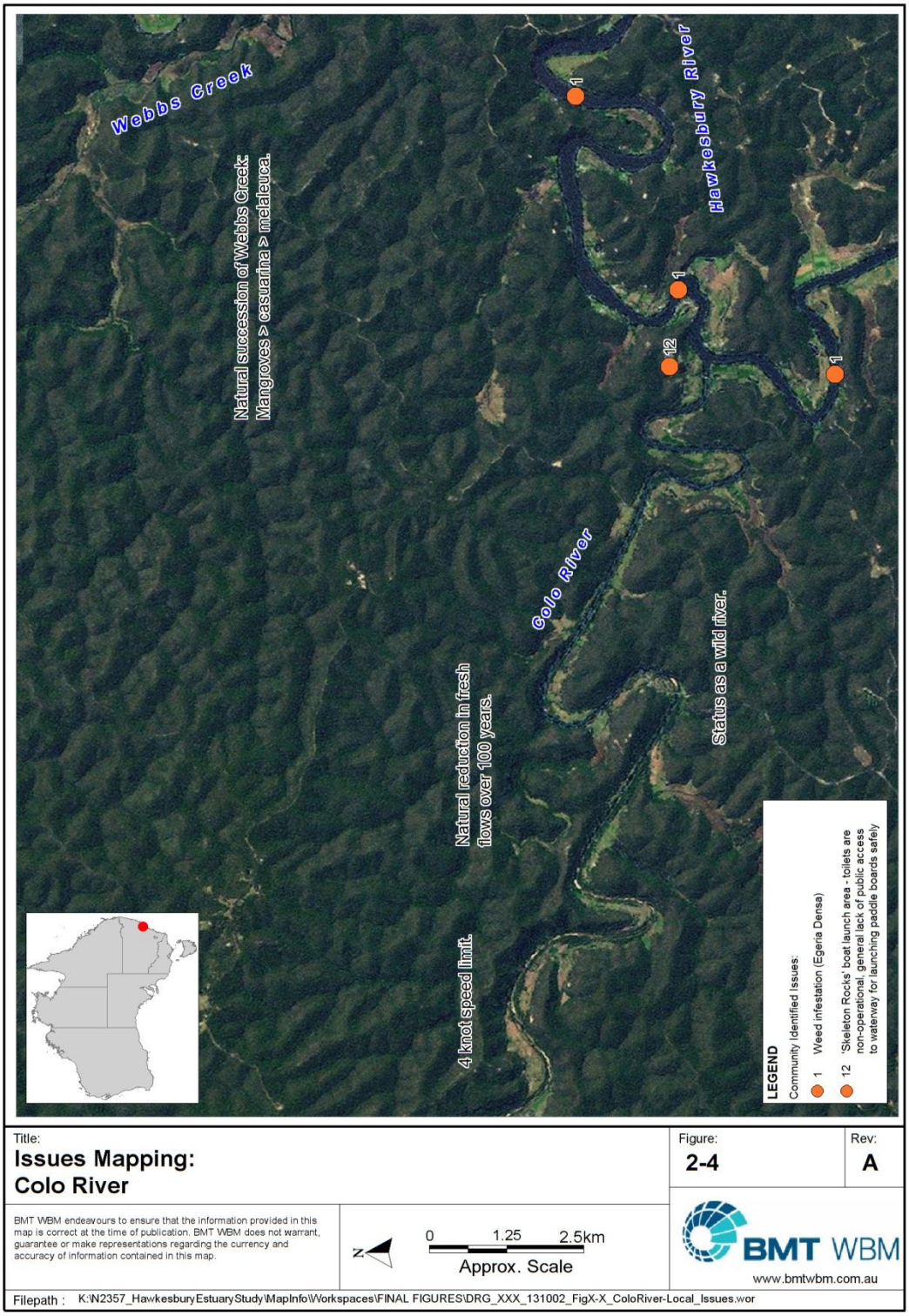


Figure 2-4 Issues Mapping from Consultation Colo River

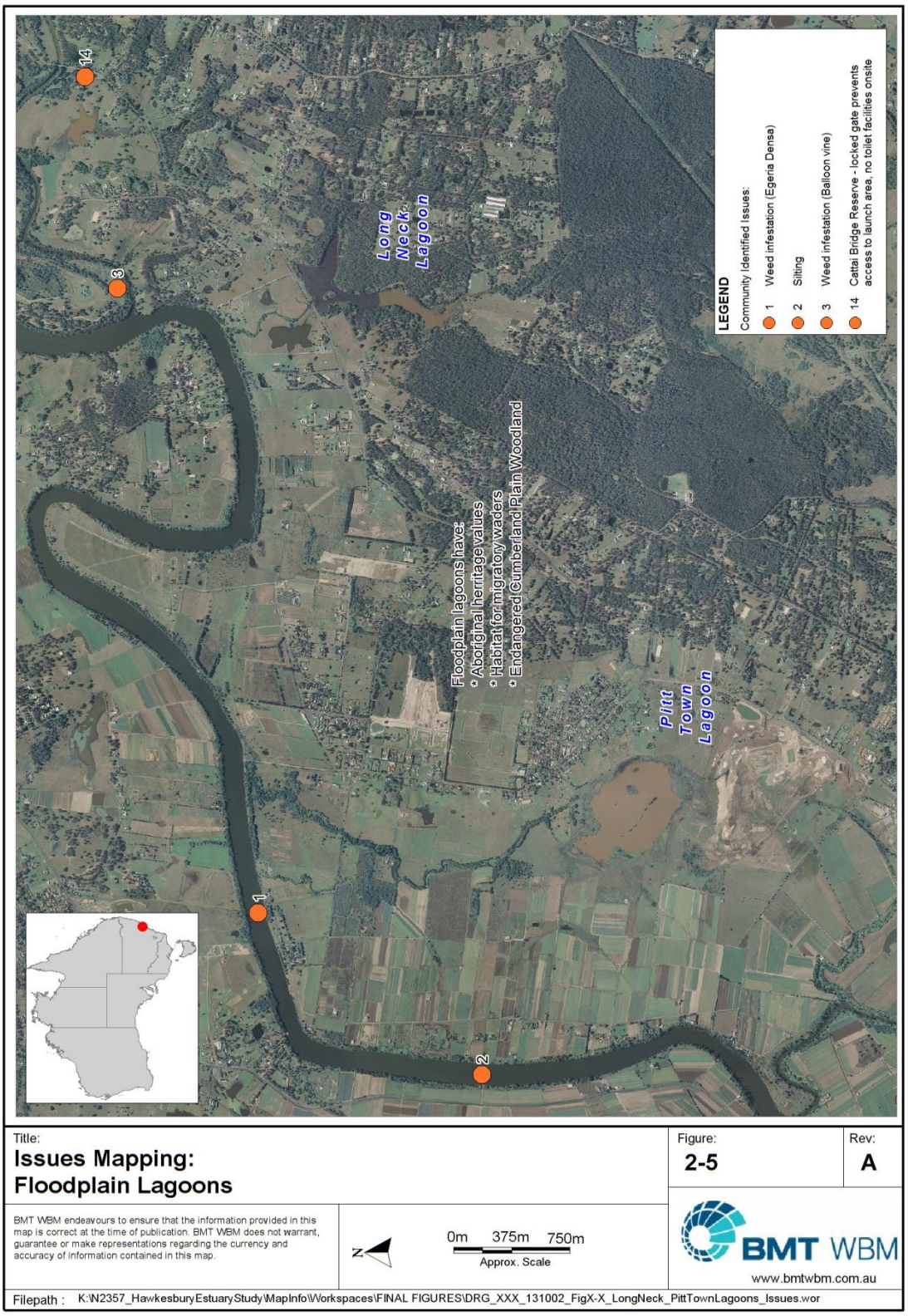


Figure 2-5 Issues Mapping from Consultation Floodplain Lagoons

3 Target Threats

A long list of issues 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 the CZMPs will be those mostly under the influence of Council.

A series of summaries are provided below covering the most significant threats to the estuary, and this will be the threats that the CZMP will focus on. Where available, maps are also shown. More information on the available scientific data regarding particular pressures such as water quality trends are detailed in the Synthesis Report.

Figure 3-1 Collation of Information to Identify Eleven Target Threats

3.1 Threat 1: Riparian Land uses

Description

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

- Encroachment of private development onto public land (e.g. Holmes Drive Reserve).

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.

- Cattle Access to banks.

Cattle access is apparent in various locations throughout the study area. Cattle access contributes to bank erosion and impacts on water quality.

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

Riparian vegetation holds different values with 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 form an important connection to the aquatic food chain. Snags contribute to fish habitat by creating relatively still areas and zones of increased flow. This variability provides resting places for fish away from strong currents and predators.

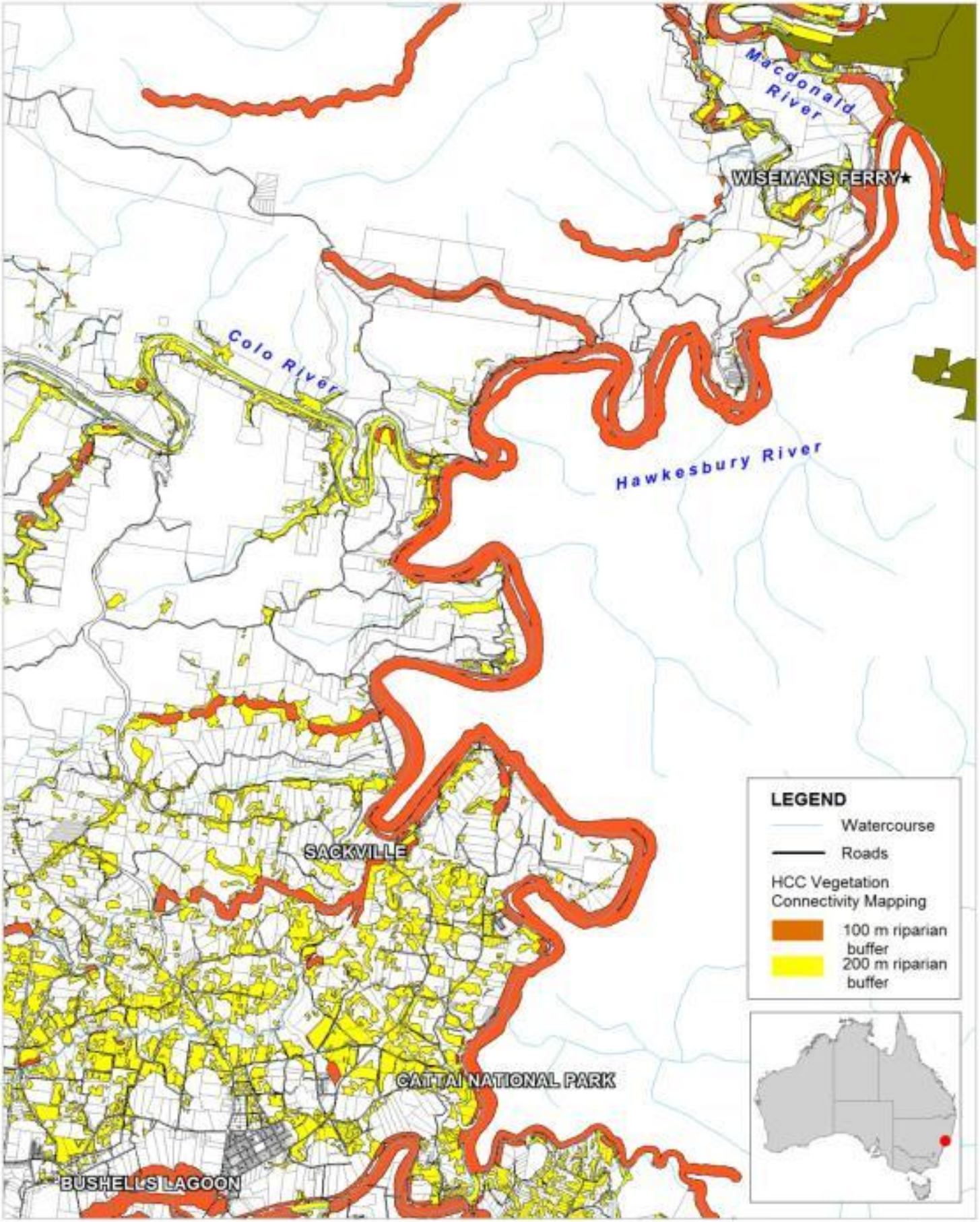
Views to the water are highly regarded and some people deliberately clear vegetation to facilitate this. Mapping undertaken for this project showed that erosion sites were predominantly characterised by riparian vegetation that was mostly cleared (39%) or absent (34%) from the riverbank

Available Mapping

Riparian buffer widths shown in Figure 3-2 and Figure 3-3

Threat Level

Reach	Threat	Reach	Threat
Upper Reaches (Yarramundi to Windsor)	High	Colo River	Medium
Windsor to Sackville	High	Floodplain Lagoons	High
Sackville to Wisemans Ferry	High		



Title:

Upper Hawkesbury River (lower reaches): Hawkesbury City Council Vegetation Connectivity

Figure: 3-2

Rev: A

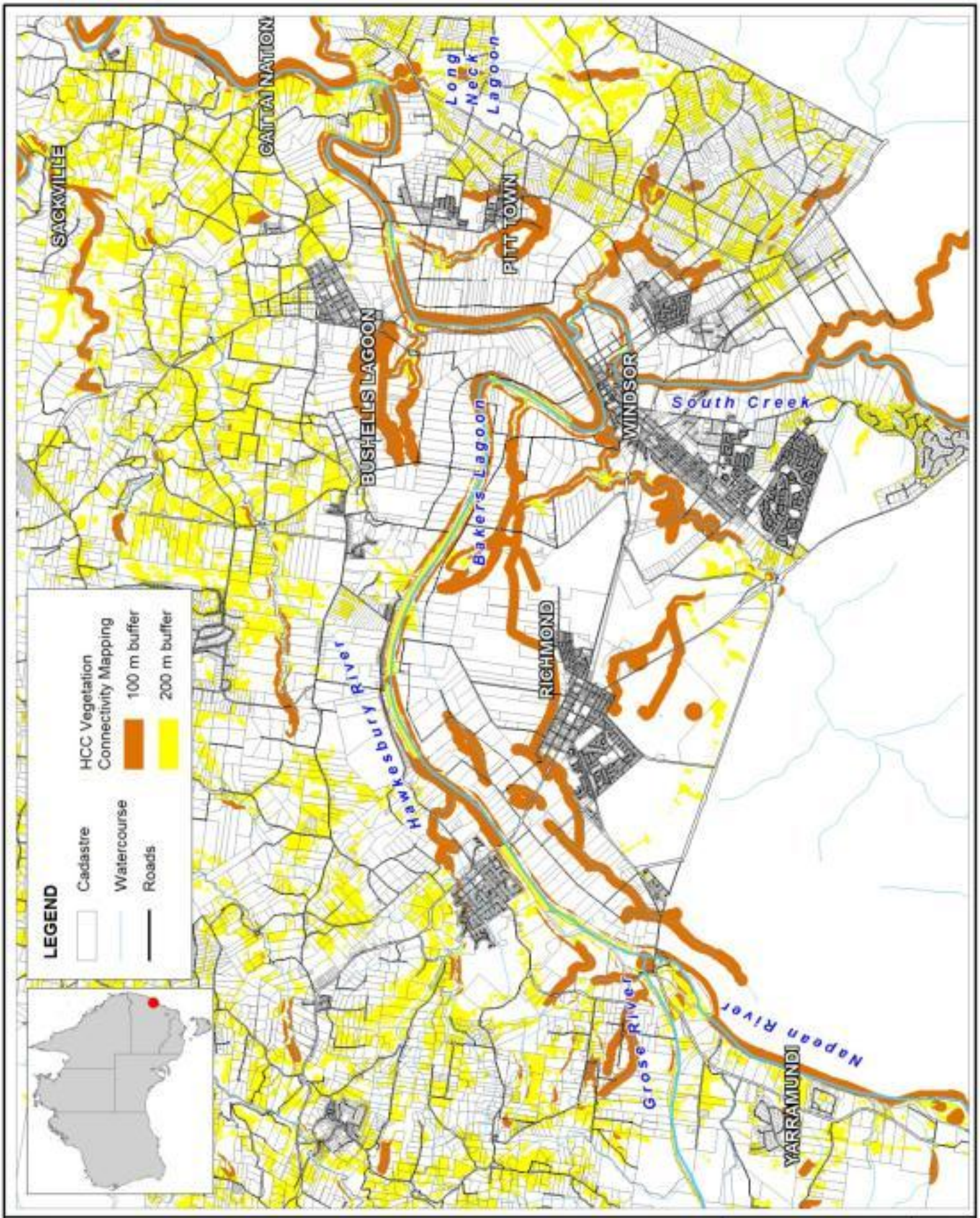
N

0 2.5 5km

Approx. Scale

BMT WBM
www.bmtwbm.com.au

Filepath : File



Title:

Upper Hawkesbury River (upper reaches): Hawkesbury City Council Vegetation Connectivity (HCC)

Figure: 3-3

Rev: A

0 2.5 5km

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath : xxxxxxxxx

3.2 Threat 2: Water based Development

Description

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:

- If improperly designed, structures such as these 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.
- These 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 design for future structures.
- The ad-hoc nature of structures built to no specific standard results in an impact to visual amenity.

Available Mapping

Recent inventory of foreshore structures (please refer to BMT WBM 2013b for further details).

Threat Level

Reach	Threat	Reach	Threat
Upper Reaches (Yarramundi to Windsor)	Medium	Colo River	Low
Windsor to Sackville	High	Floodplain Lagoons	Low
Sackville to Wisemans Ferry	High		

3.3 Threat 3: Catchment Landuses

Description

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

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

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 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. Although not included in water management planning activities, stormwater delivers water to the river and this needs to be considered in the selection of management options.

- Agriculture

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 *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 are considered in any proposed new mining or exploration developments within the catchment.

Available Mapping

Landuse zoning mapped in Synthesis report.

Threat Level

Reach	Threat	Reach	Threat
Upper Reaches (Yarramundi to Windsor)	Medium	Colo River	Low
Windsor to Sackville	High	Floodplain Lagoons	High
Sackville to Wisemans Ferry	High		

3.4 Threat 4: Weed invasion in Riparian Areas

Description

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 donas)* 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 may have a lesser capacity to protect eroding banks than natives.

Available Mapping

Mapping is available in BMT WBM (2013b).

Threat Level

Reach	Threat	Reach	Threat
Upper Reaches (Yarramundi to Windsor)	High	Colo River	High
Windsor to Sackville	High	Floodplain Lagoons	High
Sackville to Wisemans Ferry	High		

3.5 Threat 5: Illegal Dumping of Waste along the Estuary

Description

- This includes fill, crushed rock and other ad hoc materials. These substances have the potential to impact on ecology and increase sedimentation rates.
- Compliance activities from Hawkesbury Council are understood to have declined in recent years and the CZMP will consider the potential of increasing compliance activities.

Available Mapping

No mapping of illegal dumping is available at this stage.

Threat Level

Reach	Threat	Reach	Threat
Upper Reaches (Yarramundi to Windsor)	High	Colo River	Medium
Windsor to Sackville	High	Longneck Lagoon and Pitt Town Lagoon	Medium
Sackville to Wisemans Ferry	High		

3.6 Threat 6: Sea Level Rise

Description

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.

- Increased volume and salinity of tidal flows on ecology.

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

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

Available Mapping

No detailed mapping of sea level rise impacts is available at this stage.

Threat Level

Reach	Threat	Reach	Threat
Upper Reaches (Yarramundi to Windsor)	Medium	Colo River	Medium
Windsor to Sackville	Medium	Floodplain Lagoons	High
Sackville to Wisemans Ferry	High		

3.7 Threat 7: Sediment Supply

Description

- 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 Planning initiatives, compliance and educational activities and improvements to stormwater management.

- Dredging is desired by some but not supported by the available data.

A recent investigation including river bed survey data comparisons for select locations during the 1970s and 1980s, was compared with survey data from these locations obtained in September 2011. This showed the river bed changes over time by accreting during low flows and scouring during floods. Each of the surveyed sites was considered of adequate depth for safe navigation, for water skiers and wake boarders except Bens Point (which is a narrow area with a 4 knot limit). The safe minimum safe reference depth was 1.8 metres. Please refer to Table 3-1 for a summary of results. Given the environmental impacts, high costs and relatively short term impacts, dredging is not likely to be included in the CZMP.

- Impacts of high suspended sediment load on ecology.

High suspended sediment within the estuary can reduce biological activity by reducing light and impact 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.

Available Mapping

Locations identified for investigation and cross sections analysed in recent dredging feasibility assessment are shown in **Figure 3-4**.

Threat Level

Reach	Threat	Reach	Threat
Upper Reaches (Yarramundi to Windsor)	High	Colo River	Low
Windsor to Sackville	High	Longneck Lagoon and Pitt Town Lagoon	Low
Sackville to Wisemans Ferry	High		

3.8 Threat 8: Boat Based Activities

Description

- 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;
- Wake boarding and water skiing contribute to bank erosion, and there is no limit on the number of boats using the estuary at any one time; and
- Other boat based activities include commercial fishing, prawn trawling and eeling and ferry operations.

Available Mapping

No mapping of boat-based activities is available at this stage.

Threat Level

Reach	Threat	Reach	Threat
Upper Reaches (Yarramundi to Windsor)	Low	Colo River	Low
Windsor to Sackville	High	Floodplain Lagoons	Low
Sackville to Wisemans Ferry	High		

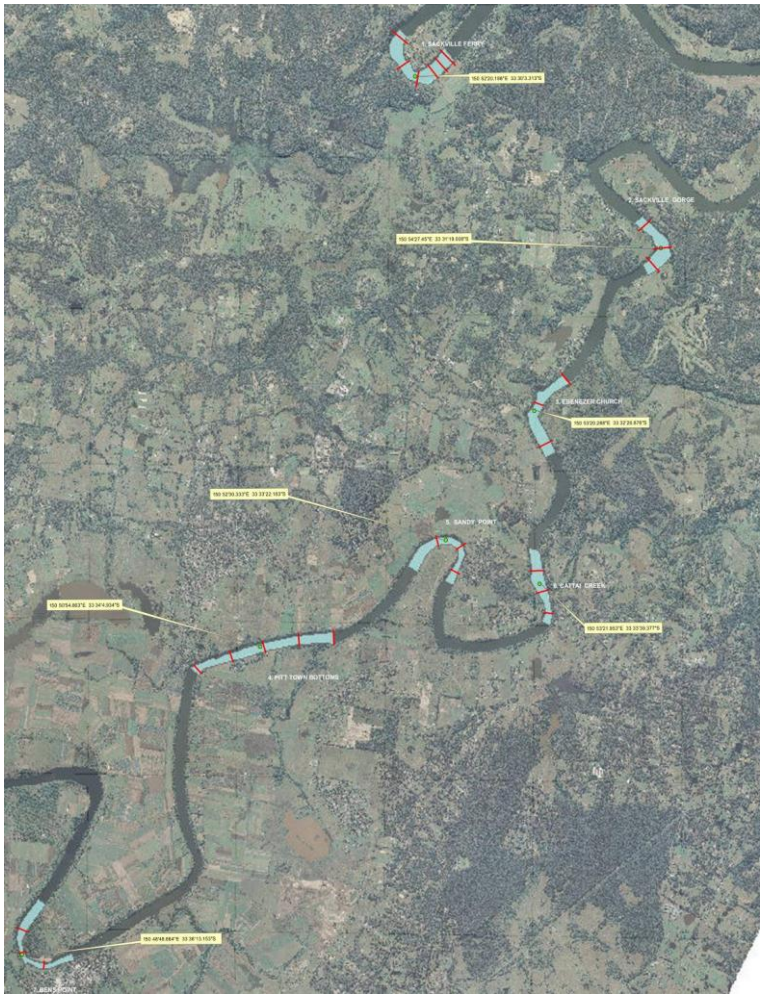


Figure 3-4 Locations Identified for Investigation and Cross Sections Analysed (source: Worley Parsons 2012)

Table 3-1 Maximum Functional Depth for Priority Locations

Location	Mean Low Water Spring Tide	Tide Reference Station (Station Number)	Reference Minimum Functional Water Depth	Location Maximum Functional Bed Level
Sackville Ferry	-0.3 m AHD	Sackville (212406)	1.8 m	-2.1 m AHD
Sackville Gorge	-0.2 m AHD	Ebenezer (212427)	1.8 m	-2.0 m AHD
Ebenezer Church	-0.2 m AHD	Ebenezer (212427)	1.8 m	-2.0 m AHD
Cattai Creek	-0.2 m AHD	Ebenezer (212427)	1.8 m	-2.0 m AHD
Sandy Point	-0.2 m AHD	Ebenezer (212427)	1.8 m	-2.0 m AHD
Pitt Town Bottoms	-0.2 m AHD	Ebenezer (212427)	1.8 m	-2.0 m AHD
Ben's Point	-0.1 m AHD	Windsor (212426)	1.8 m	-1.9 m AHD

3.9 Threat 9: Private Ownership of Foreshore Land

Description

- Bank Condition.

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

- 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.

Available Mapping

Publically owned land is mapped in Figure 3-5 and Figure 3-6.

Threat Level

Reach	Threat	Reach	Threat
Upper Reaches (Yarramundi to Windsor)	High	Colo River	High
Windsor to Sackville	High	Floodplain Lagoons	High
Sackville to Wisemans Ferry	High		

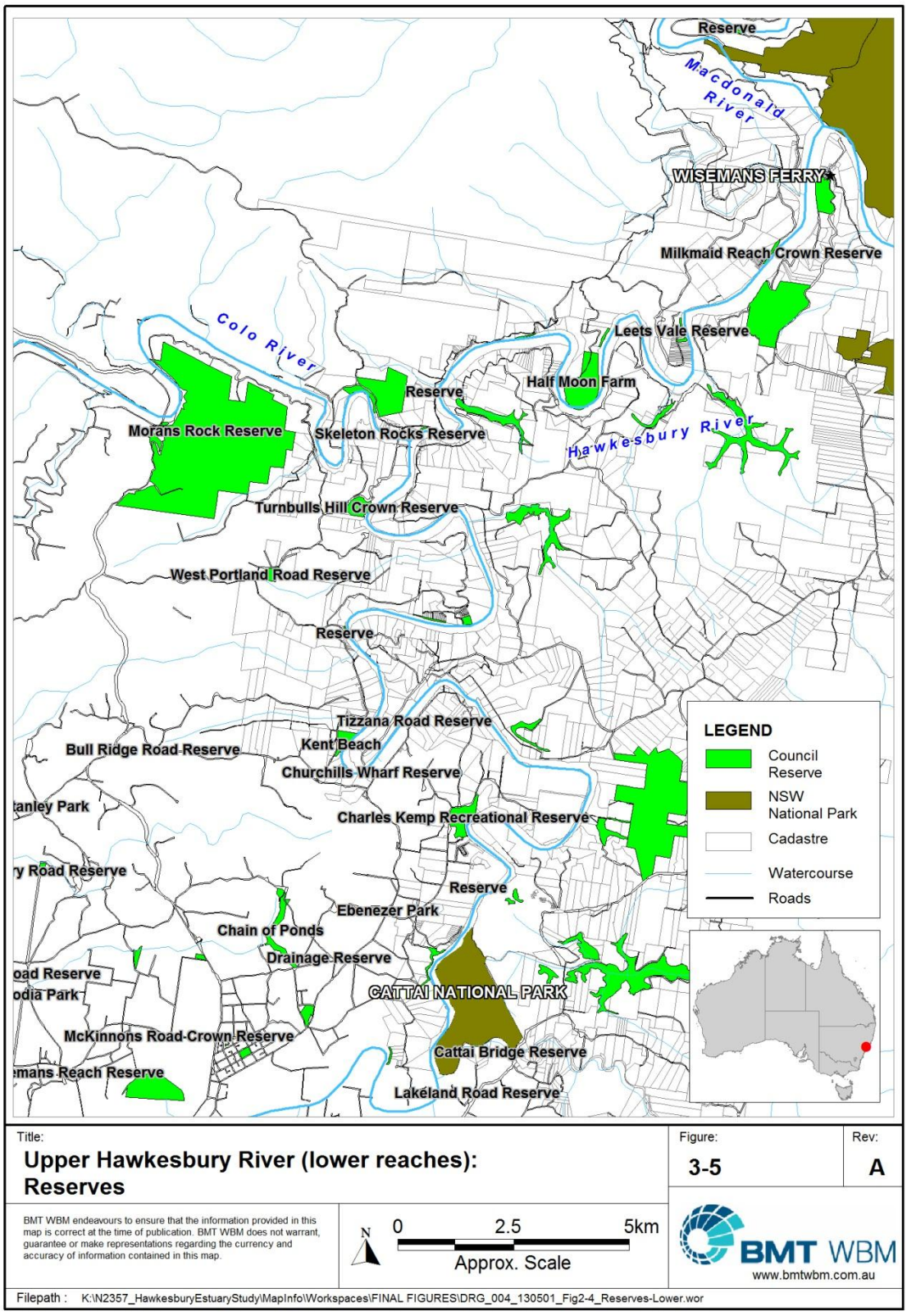


Figure 3-5 Publically Owned Land in the Lower Reaches

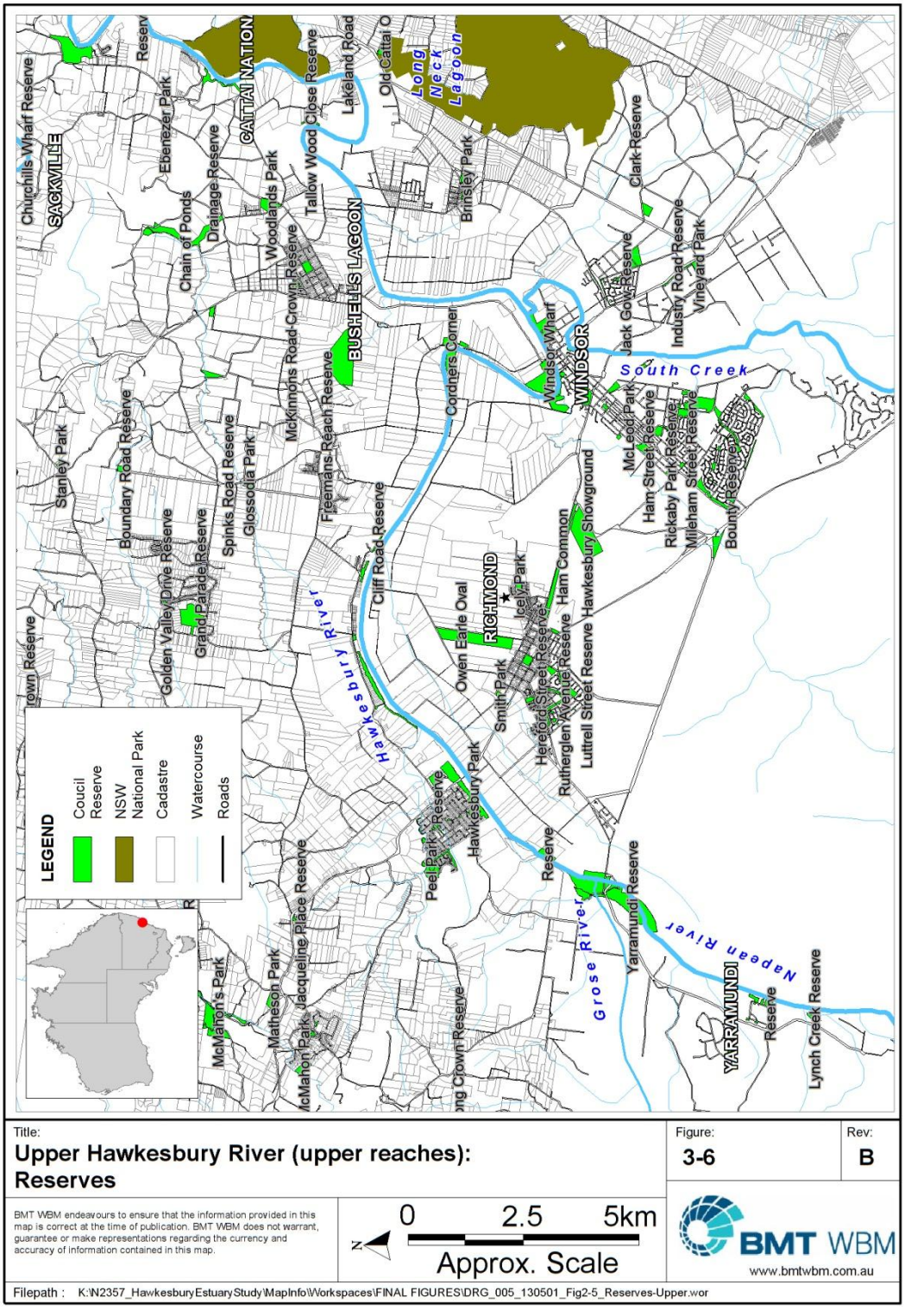


Figure 3-6 Publically Owned Land in the Upper Reaches

3.10 Threat 10: Sewage Treatment Plant Discharges

Description

- 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 should be sought 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.

Nutrient, salinity and common medications are three key concerns

Available Mapping

No specific mapping of STP discharge impacts is available at this stage.

Threat Level

Reach	Threat	Reach	Threat
Upper Reaches (Yarramundi to Windsor)	High	Colo River	Low
Windsor to Sackville	High	Floodplain Lagoons	Low
Sackville to Wisemans Ferry	High		

3.11 Threat 11: Water Extraction and Dams

Description

- Large scale modification of the estuarine system.

Through modifying 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.

Significant for the study area.

- 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 widening in response to this.

Available Mapping

No specific mapping of water extraction and dams is available at this stage.

Threat Level

Reach	Threat	Reach	Threat
Upper Reaches (Yarramundi to Windsor)	Extreme	Colo River	Low
Windsor to Sackville	Extreme	Flood plain Lagoons	Medium
Sackville to Wisemans Ferry	High		

4 Options

4.1 Overview

An initial 'long-list' of possible Management Options was developed, and is provided in Appendix C. The source of these options include recommendations from previous reports, community input through the workshop process, suggestions from agency representatives and other stakeholders from the threat assessment workshop, best practice approaches used elsewhere and tailored strategies developed by the Study Team.

The possible Management Options identified utilise a variety of implementation mechanisms that can act at different levels, or on different aspects of the problem. 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.

It is not practical or affordable for Council to implement all of these options, therefore a methodology for prioritising options was developed. The result is a list of recommended options to achieve the management objectives within an affordable and realistic framework.

In accordance with a risk management approach, Management Options are designed to reduce the frequency of a threat occurring or to reduce the severity of the consequence of the threat occurring or both. In this regard options have been categorised as either an *intervention option* or an *adaptation option*.

Intervention options are those designed to reduce impacts of threats on natural values. These are typically options that address issues at the source.

Adaptation options are options to improve resilience of use (by the environment or the community) to modified values. These options typically address issues by improving the estuaries capacity to accommodate threats.

4.2 Next Steps

The understanding of processes, values and issues essential for developing a working management plan has been built through this project in an iterative manner. The starting point was the plethora of reports and documents that have been prepared previously outlining the processes values and issues peculiar to the study area.

Through the project tasks and consultation there is now some understanding of what is valued in each reach of the estuary and how it is changing. During the stakeholder workshop the group was also asked to consider *how much change are we willing to accept*?

The study area is recognised by a range of stakeholders for community, environmental and economic values. The estuary is modified from its natural state, and to some, these modified values are desirable. An example is the striking lack of riparian vegetation along some sections of the river, which some people desire to maintain views of water-skiing.

The next step will be evaluation of management options and drafting of the Draft CZMP. While it is reasonably achievable to develop a list of actions that will improve estuary health, the real challenge lies in prioritising resource allocation within the boundaries of legality, practicality and tolerable change.

The criteria by which the management options will be considered include:

- Level of threat addressed;
- Effectiveness in reducing threat;
- Time frame;
- Cost;
- Practicality / legality; and
- Community support.

5 References

BMT WBM (2013a) Upper Hawkesbury River Estuary Coastal Zone Management Plan – Synthesis Report (IN DRAFT)

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

Worley Parsons 2012 Hawkesbury River Dredging Investigations Summary Report

Appendix A Issues and Comments from the All Day Information Exchange

Issues discussed included:

The development assessment process for the use of barges by the turf farms (impacts amenity and potential dangerous in a flood)

Erosion and sediment control measures used at the site

How are turf farms regulated? What is being done to regulate the impacts? Can we use examples from the GB Reef and sugar farming?

Weeds

Concerns that restrictions will be placed on water skiing through this process

Size Pitt Town boat ramp inadequate

Insufficient parking

Access difficulties

Parking is at the top of the road and to hard to walk to with a canoe

Could parking be provided under the water tank?

Speed boats take over the River and swamp the smaller crafts.

An area for quiet boating and recreation should be designated

Pitt Town is a user friendly area

Dredging is not having enough of an impact on the rock wall at Governor Phillip Park.

Willow trees along the bank hold the banks together well. When they die they wither and slowly decompose with little impact on the bank. Concern that Casuarinas are the wrong choice for bank protection and cause further erosion.

Raise the dam wall and this will permanently raise the height of the River to recent flood levels but will minimise the impacts of a big flood.

The need for more stringent controls on noise from power boats

Comment that Council managing the removal of debris along the river really well over the past few years. There wasn't a lot built up in the latest flood.

In the past successfully fought off private company that wanted to use water from the local springs. Pristine are with Highland Peet (swamps on sandstone) and Giant Dragon Flies

Concerned about the issue of Coal Seam Gas exploration and that Council had permitted work to go ahead

Lack of backburing by the RFS behind Mt Lagoon. The area hasn't had any hazard reduction for 15 years.

Impacts from the fire on the river will be from ash, dead animals, trees.

Wilberfore is considered to be a more affluent area and would be good to conduct consultation there.

Richmond town centre dying. Shops closing down. Hours are very short.

New shops to be built at Riverstone will also impact on Richmond

Terrance Road North Richmond, a lot of trees have been recently knocked down

Peels Dairy trees have been knocked down for unimpeded use of the irrigation machines

Speed boats at Richmond

Create more access so that people can use and appreciate the river

Put in an extra ferry service at Lower Portland

Siltation at Wisemans Ferry

Bridge crossing of the Grose River as a result of new development

Impacts of sandmining

Lack of opportunity to hire a tinny or similar and enjoy the area

Comment that if people were using it and paying to use it (i.e. hiring a tinny) then it may be more valued.

Appendix B Compilation of Results from Community Meeting

B.1 Values

Values

	Group 1		Group 2		Group 3		Group 4		Group 5		Group 6		Group 7	
Value	**Present**	**Comments**	**Present**	**Comments**	**Present**	**Comments**	**Present**	**Comments**	**Present**	**Comments**	**Present**	**Comments**	**Present**	**Comments**
Natural Bushland / riparian vegetation	X			Important for Water quality Management	2		X	Natural bushland present however there is major weed infestation. Help to protect the environment as it needs to be protected. Erosion is a problem High value of native plants and not weeds to ensure the health of the area			X	Managed	X	Bankside erosion, Weeds
Views / aesthetic beauty	X						X	Valued by residents who see the view needs to be balanced by riparian bush. Areas of river where there is access for people. Eg Cattai park people cant use it to get to river.			X		X	
Access to waterway	X	Needs more access points on public land for watercraft	X	Pathways - along River - Yarramundi to Windsor - Correction not patches & single precincts			X	Well managed and maintained access points - if done well, it can prevent unnecessary removal/damage of inactive bushland			X	Manage better access	X	Limited re public eg reserves/ ramps limited
Presence of threatened species	X		X				X	Control of pollution from residential and agricultural practices			X	Linked to priority 1	X	
Recreational Opportunities	X	Lack of picnic places to pull off					X	Insufficient control of some recreational opportunities speed boating, skiing and boarding			X	Population growth will lead to pressure on River	X	Limited so much private ownership
Water Quality	X	South Creek effecting water quality. Better up river from there. Cattai creek too - new developments contribute.	1	Drink - run of river - sewerage treatment discharges right near water extraction	1		X	Very important flows onto health of fish extension of this is effective in the river			X	Priority 1	?	Problem - STP's, agric, weeds/erosion/silation
Heritage / cultural values		Aboriginal Significance		Value this - we are first footprint and European settlement in Australia			X	More awareness needed of cultural heritage sites			X		X	2 Aboriginal Reserves, Locals heritage / cultural values still
Tourism Potential		See HHART Destination Management Plan		Link Herniate and water connection - What a contribution			X	Brings $$$ into the region. Hawkesbury doesn't capitalise on this assets as much as it should			X	Managed correctly	X	Variety available water based/ bird watching/access silted.
Fish habitat values	X			Corrected - Eco system - so natural assets are all linked	3		X	Very important - is an indicator of healthy habitat and general 'river health'. Need to maintain flood plains lagoons particularly those that are threatened like bushells lagoon.			X	Linked to priority 1	X	Loss of habitat/water quality eg oyster farmers/ erosion
Water bird Habitat	X			Mines at Darling ????/Bell							X	Linked to priority 1	X	Bass spawn specifically in this stretch. OHRCZ. Lagoons/lack of width/reduced species diversity weeds support some species.
Other values added on sheets														
Water source for agricultural businesses														
Historical	X	"Food Bowl' history 1. Aboriginal Agriculture												
Residential		Bank erosion - Residents, on river are not allow to fix some poorly managed dredging has worsened erosion flooding can affect.												
Grose River				Poison travel down waterway into upper Hawkesbury sound filtering at Grose										
STPs				ZZ discharge to Hawkesbury - water no drink										
South Creek				Water quality - sewerage discharge										
Buffer Zones				40 metres - no remove veg but can graze cattle										
Sand Mining				Remove entire Lowlands - 2nd Penrith Lake. When are we to be told?										
No buffer Zones														
Riverbank Protection							X							
Commercial Fishing									X	Commercial Fishers rely on the Health and Productivity of the River				
Adequate Flows										Flows are essential for Fish productivity				
Flood Tides										Tides are essential to keeping river clean				
Clean River									X	People cut down trees and leave them where they are on flood plain				
Clear River									X	Egerai Densa weed infestation				
Agriculture											X	Priority 2	X	
Commercial Fishing											X	Priority 3	X	
Water Resource													X	Water drawn from river for domestic irrigation
Gravel & Sand Extraction													X	
Ecological processes														
Ferries (Transport)														

B.2 Threats to Identified Values

B.2.1 Water Quality

	Value : Water Quality				
	What threatens the value?	What could happen?	What is already being done to address this?	What locations within theriver does the threat occur or have the potential	Do you have any suggestions for addressing the threat?
	South Creek industrial pollution	Further pollution gets worse	Increased Fines	South creek and down stream	Property designed (natural)
	Cattai Creek residential development	Further pollution gets worse	??	Cattai Creek and surrounds	Storm water, retention and design
	Lack of natural flow - eg Warragamba Dam	In drier periods blue green algae worsen	STP flows going in. Releases from Nepean dam/environmental flows.	General Waterways	More releases from dams. Raise the wall then release
	Siltation in the river - sediment control needed	more murky/worse	Farmers putting in more ponds	General Waterways	Increased education / programs from DPI
	Intensive agriculture	More chemicals no education on	Regulation	General Waterways	Education
					Recycling Sydney sewerage
	South Creek	Loss of all river values	AWTP operating to clean % of water in	All	Clean it up
	Water depth and low flows	Loss of all river values	GHN WSP has increased flows - nil on	All	Increase Flows and cleanout
	Siltation	Loss of all river values	Riverbank vegetation & turfing farms	All	Stop stock grazing in river,
	Urban waste eg plastic containers	Loss of all river values	GPT (Gross ????? Traps)	All	more GPT's
	STPs Discharge	Loss of all river values	AWTP three towns sewerage added	All	upgrade Winmalee STP (all
	Water Discharge from W. Dam Temperature and bugs	Loss of all river values	nil (?)	All	Release water from warmer sect of dam
	Illegal Waste Discharges	Loss of all river values	Reactive	All	More detailed surveillance
	Mining	Disturbing habitats wastewater. Leaching from mines	We don't know	Richmond Lowlands - Sydney Regional Environment Plan No 9	No CSG wining catchment, no sand mining on Richmond
	STP Releases	Bypass value failure - untreated	Monitoring ? No monitoring at North	Various points along river and	Secondary control to prevent
	Urban runoff	Detergents, fertilisers, general	Nothing	South creek	Filtration easements
	Agricultural runoff	Fertilisers, turbidity, beach	Nothing	Various points along whole upper	Filtration easements. Replant
	Boating	Bank erosion, Fuel leaking	Nothing	Entire upper Hawkesbury	Monitoring and development of minimum standards.
	Urban Stormwater	Community education. WSUD Monitoring	DA have used monitoring? Stream watch	Everywhere	Education, monitoring, transparent reporting
	Agricultural runoff	Increased inspection and regulation environment	AG scale, WSD, Fed, Govt, programs. "sustainable farms" "water start farms"	Everywhere	Resources for improved management, education and compliance
	Reduced Environmental natural flows	Don't raise Warragamba Dam	H.N.V Flood review, recommendations 2013. Current e-flows from upper Nepean Dams	E-flows assessment for Warragamba Dam. Downstream of dams	Increase volume and frequency of flows
	Aquatic Weeds	All weeds removed			
	Nutrient Input	More Efficient application of nutrients. Retrofit stormwater drains. Community	River Recovery	Whole catchment: Residential, Industrial, Agricultural	Training, engineering, education
	STP discharges	Better treatment increased recycling. Minimum quaternary treatments	Upgrade of N. Richmond. "St. Marys" - STPs	Any STP outlet	Lobbying by community, stricter regulation by State Government
	Sedimentation from land use	Maintained access points, clearer signage construction segments			
	Long wall mining and CSG in the catchment				
	Sewerage from housing industry and nutrients, run-off from commercial farming	The river could die. Cannot use the river for recreation. Could not support commercial farming on fishing	Sewerage - Do not know the level of control for sewerage into the river.	Sewerage Plants - Windsor to Katoomba	Sewerage - Strict Management plan in place, monitoring outcomes large penalties for abuse.
			Nutrients farmland - Nutrient ponds are being built on the farm to assist in controlling nutrient	Nutrients - Farmland	Nutrients - Government sponsored funding to assist landowners and stake holders to put appropriate structures in place

B.2.2 Commercial Fishing

Value	Commercial Fishing			
What threatens the value?	What could happen?	What is already being done to address this?	What locations	Do you have any suggestions for addressing the threat?
Water Quality	Loss of Industry	STP's Upgrade	All	STP upgrade, urban runoff
Water Flows	Loss of Industry	Water sharing plan	All	Dredging
Water Temperature	Loss of Industry		All	Dredging
Siltation	Loss of Industry	Re-veg not enough	All	Dredging
Exotic Weeds	Loss of Industry	Increased flows, less nutrients	All	Dredging
Riparian	Loss of Industry		All	Controlled Planning
In stream Structures	Loss of Industry	Planning process - not policed	All	Controlled Planning
Conflict between	Loss of Industry	Nothing	All	Education
Fish & EEL Barrier	Loss of Industry	Nothing	All	EEL Slide
In river - aquatic	Flow and river water	Egeria Densa is considered to be too	From below	Must have adequate flows flood
Poor water quality	Fish do not survive or lower productivity red	Flow Management has been changed from dams and reverse	From below Penrith Weir to	Maintain flows from Dams. Continue to increase treatment plants
Silting of River	The river shallows changed and	Flow Management.	From below Penrith Weir to	Caution river extraction - water sharing etc
Flows	Developments requiring more and more water	Dam releases water management plan water sharing	From top to bottom	adequate planning in sewerage/drainage
Effluent going into river	Continued growth of developments - no	?	From Windsor Wisemans	Stop developing high use areas without adequate treatment of
Developments along River	River water quality deteriates chemicals in	?	Windsor to Wisemans	Evaluate the ability of the river to absorb increased use
Foreshore Erosion	Silting of river	CMA - Contact and forshore focus	Full Length	Stop boats using ballast to make
Removal of Reeds	Foreshore erosion	CMA - Community Awarness	Clifton Ville	Community awareness penalty

B.2.3 River Bank Quality

Value : River Bank Quality				
What threatens the value?	What could happen?	What is already being done to address this?	What locations	Do you have any suggestions for addressing the threat?
Restrictions on bank management	Erosion	Landholders not permitted to manage	River Banks	Easier/streamlined process for permits to manage banks - access to different methods of bank
Certain agricultural uses/practices	Increased erosion - (ie livestock on banks)	Not known	River Banks	Use troughs/alternative methods of water livestock
Inappropriate dredging close to banks or on	Bank collapse and erosion	Dredging not permitted currently	River Banks	Dredging ceased
Inappropriate vegetation on banks	Bank collapse and erosion		River Banks	Education for land holders on appropriate vegetation and bank management strategies
Erosion - flood, stock, water runoff, wave action	Loss of vegetation and natural habitat. Loss of land	Mass planting of various native plants, has had limited success on erosion	All locations with the exception of the natural rock toe.	Engineered controlled toe protection. Must be supported by Government departments working together with stakeholders and landowners
	Instability of foreshore, safety issue from immediate collapse of	Various materials and structures to stabilisc look unsightly also limited		Documented procedures to enable stakeholders and landowners to carry out bank protection
	Large deposits of soil into the	Controlled toe protection engineered		Access to funding to enable this to happen
				There is limited river bank it needs to be

B.2.4 Agriculture

Value :Agriculture				
What threatens the value?	What could happen?	What is already being done to address this?	What locations	Do you have any suggestions for addressing the threat?
Poor Water Quality	Loss of employment	Nutrient smart farms, water sharing	Yarramundi to W/F	See comment regarding water quality
Water Supply	Loss of employment	Nutrient smart farms, water sharing	Yarramundi to W/F	Dredging
Weeds and Trees	More Erosion	Weed harvesting to an extent	Yarramundi to W/F	Need attention or more dredging

B.2.5 Aesthetics

	Value :Aesthetics				
	What threatens the value?	What could happen?	What is already being	What locations within the lagoon does the threat	Do you have any suggestions for addressing the threat?
	Mass planting or native trees with the view of controlling bank erosion	People become more disconnected with the river	?	National Parks and entire foreshore where people gather to	A more realistic view to balance the needs and view of the river with
	Generalistic approach that the entire foreshore should be covered with trees. This is implied by Government, local or community land care groups.	Restricts use of parkland and private land			
		Impacts tourism opportunities			
		People by pass governing authorities			

B.2.6 Tourism Potential

Value :Tourism potential				
What threatens the value?	What could happen?	What is already being done to address this?	What locations within the lagoon does the threat occur or have the	Do you have any suggestions for addressing the threat?
Lack of facilities and suitable access to waterway on public	Provision of additional access points to river for passive	NPWS attempting to encourage use of parks to access water for	All waterways in scope of management plan	Provision of access points, toilets and facilities for passive
Pollution	Management of stormwater and	Council regulations for new	All waterways in scope of	Management of runoff -
Locked facilities and boat ramps	Open facilities	Nothing known	All waterways in scope of	Provision of facilities at sites

Appendix C Options Long List

This list is a compilation of suggestions from a variety of sources.

- Coordinating weed management efforts between the County Council, Bushcare and Landcare (including willow warriors) and the LALC to maximise benefits for the estuary.
- Close river to all but emergency boats during very high water (floods/ King Tides) to reduce bank erosion during these conditions.
- Increase compliance activity on the river for pollution / dumping. Increase public promotion of implications for offenders.
- Increase fines for dumping / pollution.
- Encourage the installation of filtration systems for runoff from farms (artificial wetlands) -refer to later option.
- Lobby for an increase environmental flows.
- Eel slide at dam wall-refer to later option.
- Provision of access points, toilets and facilities for passive boating away from powerboat ramps.
- Water quality monitoring for public recreation, including publicising results.
- Provide centralised up to date weed mapping. (will help facilitate 47).
- 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.
- Provide targeted education for agriculturalists within the catchment.
- Develop a monitoring strategy for key water quality parameters.
- Educate and encourage residents to plant reeds and rushes on shoreline so does not detract from their view.
- Clearly outline the relevant planning framework around water based development and identify opportunities to improve this to ensure appropriateness of future development.
- Resource rehabilitation of barriers to fish passage.
- Preparing planning notes for Council DA assessors on appropriate structure types for submitted Das.
- Ensuring that where Council is responsible for building structures that best practice is used.
- Preparing DA advice sheets for Non English Speaking community.
- "Give advice to people submitting DAs but also ensure that HCC are following our own advice and using these structures (check with Parks as to what structures they recommend particularly around Windsor boat ramp where we are currently putting in erosion control structures).
- "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.

- "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.
- "There are different types of groups of people submitting DAs - Turf farms, agricultural land use, caravan parks/ski parks, individual properties. Specific advice sheets should be prepared for the different groups. Non English speaking advice is needed for agricultural farmers. Diagrams are best. Make people aware that Council is responsible for regulating these issues and they can't just do anything they like as may occur in their country of origin.
- Minimise the number of structures in a DA - i.e. not multiple access points evident at the caravan parks.
- 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?
- HCC should provide advice on river bank management with the Das. Provide information to planners to allow this.
- Develop a method checklist which enables local council planners to continually assess the likely impacts of DAs upon the natural processes, estuary values and sustainability of the Upper Hawkesbury Estuary.
- Negotiate an MOU between Hawkesbury and Hills Councils to regulate development along the Upper Hawkesbury Estuary.
- Maximise potential of limited publically owned land for recreational opportunities.
- Demonstrate best practice land management on publically owned land.
- Lantana and other weed removal and subsequent rehabilitation of the cemetery site for public use.
- Combine rehabilitation works by Aboriginal green teams with the opportunity to undertake an Aboriginal Assessments on private and other lands.
- Dredge the river at various locations between Sackville and Windsor.
- Consider employing a Riverkeeper.
- Support the implementation of the River Health Strategy implementation of actions to benefit the estuary (fencing, riparian revegetation etc.).
- Work from priorities determined by the HNCMA through the River Health Strategy.
- Prepare and implement an holistic foreshore access plan. Control - plan and nominate certain areas for certain uses, creating designated areas for public toilet facilities, parking, boat ramps. More user friendly areas.
- To identify heritage values and protect items - fence off and monitor it.
- Planned subdivision to prevent access to river and increase in riparian rights.
- Algae/Weeds - reduce nutrient levels (e.g.. Urban runoff); increased (env) river flow.
- Extent of bank erosion - controlled use of waterway; bank revegetation/stabilisation; manage points of access - people, stock.
- Update development control plan to inform water based structure construction.

- Increase fines for dumping / pollution.
- Increase freshwater flows.
- "Water Quality - DO - control of agricultural and urban runoff - sediment/nutrient control.

  - Turbidity - control of illegal placement of fill along river.

  - Sediment - increase discharge STP; improved management of on-site sewage system; increase river flows."
- Council continue to support research which improves understanding of river condition /cause and effect in order to develop improved management practices.
- Write a specific WSUD chapter in the Hawkesbury DCP
- Incorporate climate change considerations into infrastructure asset management and planning processes.
- Actively support the continuation of Bush care to assist with revegetation works on Public and Private Lands.
- When undertaking reviews of strategic planning initiatives (including LEPs and DCPs) ensure consistency with the objectives of the CZMP.
- 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.
- 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.
- Retrofit appropriate WSUD in existing urban areas including measures such as artificial wetlands, vegetated swales.
- Reduce potential sewage contamination to the river, through identifying sources, increased auditing of onsite systems and where possible, connect rural residential residences up to the sewer network.
- Continual documentation of implementation including challenges (funding, logistics, community concerns etc.), achievements and failures to inform adaptive management.
- Undertake adequate and appropriate maintenance of existing WSUD devices to maintain their effectiveness, in particular GPTs, nutrient filters and other stormwater quality improvement devices.
- Prepare a site specific guideline for environmentally friendly seawalls in the Upper Hawkesbury River.
- 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)
- Pilot projects to showcase best practice riparian vegetation.
- 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.

- 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
- Undertake compliance on unauthorised use and development on riparian and estuarine vegetation areas.
- Encourage the planting of appropriate species to enhance connectivity, green corridors and succession of desired adult trees
- Undertake bird and fauna surveys along the river to assess conservation value and inform future management.
- Capitalise on any opportunities to acquire privately owned foreshore lands, bringing them into public ownership to improve and enhance public access and ecological values.
- Ensure latest research on boat wake, speed limits, boat type and erosion are considered in recreational zoning of the estuary.
- Continue to work with WRL and others to understand relationship between environmental flow regime and estuary health.
- Know the Flow -program to ensure accurate measurement of extraction
- Review and update the Hawkesbury and Hills DCPs to give greater protection to estuary assets. Ensure DCPs incorporate best practise: sediment, erosion and stormwater controls (WSUD); use of water reduction devices and maximal permeable surfaces: protection of native vegetation; sewage (i.e. low risk OSSM) management; restriction of landscapes and gardens to endemic species; bank protection works etc. (refer also to 2).
- Review and update relevant DCPs in relation to rural lands to incorporate best practise land management, stock management, fertiliser and pesticide use, erosion controls and runoff controls to reduce pollutant and sediment loads from rural lands.
- Map caravan park locations - clearly defining regulations regarding caravan parks and identifying opportunities to reduce impacts/prevent further proliferation.
- Repeat audit undertaken by Steve Black to assess increase and to establish a baseline for this plan.
- Expansion of Smart Farming initiatives.
- Field days designed to remove carp from lagoons. Reintroduction of native species.
- Limit catchment population/development based on the assessment of estuary carrying capcity and ecological assessments.
- 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).
- Understand barriers to rehabilitation of privately owned banks and contribute to managing these.
- Providing additional resources for compliance activities within Hawkesbury Council (see also option 14)
- Identifying riparian and biodiversity corridors.

- Mapping estuarine vegetation and identifying vulnerabilities.
- Utilise hydraulics and WQ modelling insights coming out of present study for Sydney Water to understand processes and impacts.
- Subject to permission being granted utilise model to assess impacts of Climate Change, changes to water sharing plan and potential impacts of options.
- Communicate appropriateness of water for recreational use. (Related to 18).
- Opportunities for improvement to Council management of onsite systems.
- Develop educational materials and program to encourage best practice riparian land management.
- Appropriate waste facilities.
- Resource and make recommendations for research, zoning and compliance activities.
- Communicate natural tendency for a depositional environment and actual siltation rates.
- Strong focus on tangible action early in project.
- Limit restrict development and development controls - rehabilitate riparian vegetation - fence off banks.
- Riparian Buffer Width - revegetation - grants to private landholders; regulation.
- Have a compulsory riparian buffer of 100-200 metres.
- Identify wetland species and communities that will be impacted by sea level rise and prioritise opportunities for landward migration.
- Upgrade Winmalee STP (all STPs).
- Release water from warmer section of dam.
- Council to adopt a policy of no CSG mining in the catchment.
- No sand mining in the catchment.
- Lobbying state government by community and council regarding higher quality of water from discharges by Sydney Water.
- Stricter regulations for wakeboarding, for example restricting the use of ballast.

Appendix D Long List of Issues from the River Summit

Problems and Pressures on the River

The problems that appear below are in the prioritised sequence from each table.

By Table

Table 1

#	Problem	Categories
1	Lack of clear, long term agreed objectives and consistent integrated planning and application mechanisms across different portfolios	Institutional - Management, Funding, Skills - Resources, Monitoring, Compliance
2	Lack of breadth of community understanding of land and water management issues	Awareness and Education, Community Division
3	Lack of a natural flow regime, impacting upon aquatic ecosystem productivity, salinity intrusion, sedimentation, favours non native species, stratification and bank stability	Environmental flows
4	Not meeting national water quality objectives and poor water quality and cleanliness	Water quality, Stormwater, Sewerage, Environmental flows
5	Lack of clear and transparent water sharing arrangements for everyone	Environmental flows, Water and Irrigation, Institutional - Management
6	Future sustainability of commercial and recreational fishing	Population Pressure, Fish and Fishing, Tourism - Other Recreation

Table 2

#	Problem	Categories
1	Water flow, 97% of fresh water goes to Sydney leaving 3% fresh water or less flowing in the river	Water quality, Environmental flows
2	Too many government authorities involved	Institutional - Management, Skills - Resources
3	Government policies and regulations	Institutional - Management, Skills - Resources
4	Return of environmental flows	Environmental flows
5	River siltation and impact on navigation	Water quality, Erosion
6	Water quality, stormwater, sewerage and excess nutrients and invasive aquatic weeds	Water quality, Stormwater, Sewerage, Weeds
7	Quality of water in tributaries eg. South Creek	Water quality, Stormwater, Erosion
8	Impact of Urban development eg. water supply and stormwater run off	Stormwater, Population Pressure
9	Insufficient research and inadequate monitoring	Funding, Monitoring
10	Water extraction from the river	Water and Irrigation, Farming
11	Climate change	Climate Change
12	Fish problems including passage, barriers and habitat	Environmental flows, Fish and Fishing
13	Riparian users (stock and domestic water)	Access, Institutional - Management, Compliance
14	Management Plan objectives not being met eg. Healthy River's Commission recommendations from 1998	Institutional - Management
15	Impact of farm dams	Water quality, Weeds

#	Problem	Categories
16	Inappropriate or excessive waterway activities	Tourism - Other Recreation, Access
17	Impact of Mining	Other
18	Water run off	Water quality, Stormwater
19	Riparian corridor condition eg. bank erosion, pest, weeds and disease	Erosion, Weeds, Biodiversity
20	Impact of Government cycle eg. funding and policy changes	Institutional - Management, Funding, Compliance
21	Impact of bushfires	Water quality, Erosion
22	Lack of education and awareness	Awareness and Education

Table 3

#	Problem	Categories
1	A single independent Hawkesbury Nepean River catchment authority with appropriate responsibilities and the necessary regulatory powers with an independent funding source (eg levy) focussing on water quantity and quality and regulate its diversity of uses	Institutional - Management
2	Sustainability test for types of use within the catchment including cumulative impacts	Other
3	Education and awareness of residents and property owners within the catchment on relevant issues	Awareness and Education
4	Lack of environmental water flow - magnitude, quality and duration	Environmental flows
5	Improve water quality with the upgrading of infrastructure to avoid pollutants entering the river and contaminating the ecosystem	Water quality
6	Prevention of siltation and pollution by storm water management	Stormwater
7	Management of riparian zone to prevent bank erosion, pollution and weed infestation	Erosion
8	Flood vulnerability due to inappropriate land use planning	Flooding
9	Aquatic and riparian weed management	Weeds

Table 4

#	Problem	Categories
1	Lack of whole of government approach - requiring one single authority over all issues	Institutional - Management
2	Lack of information on condition of river system to allow informed discussion/decisions.	Monitoring, Awareness and Education
3	Insufficient flows. Need to increase environmental flows from the dams supplemented by high quality re-use water.	Environmental flows
4	Bank erosion, river siltation	Erosion, Boating
5	Over politicisation of river, need bipartisan approach.	Institutional - Management, Community Division
6	Imbalance of allocation of scarce resources	Funding, Skills - Resources
7	All beneficiaries to contribute to cost of managing river eg water pricing	Institutional - Management, Funding, Skills - Resources
8	Lack of monitoring of pharmacological chemicals in the river	Monitoring
9	Lack of clarity in the framework for regulation of illegal works	Institutional - Management, Compliance

Table 5

#	Problem	Categories
1	Single river authority with statutory enforcement powers.	Institutional - Management
2	Adequate environmental flows to ensure river health.	Environmental flows
3	Urban and rural catchment runoff/sedimentation	Stormwater, Sewerage, Erosion, Population Pressure
4	Flood mitigation.	Flooding, Funding, Monitoring, Awareness and Education
5	The allocation of water for competing uses eg agriculture and environmental flow.	Water and Irrigation, Institutional - Management, Compliance, Community Division
6	The sewerage treatment plants eg water quality.	Sewerage, Population Pressure
7	Protect commercial, agriculture and recreational users that rely on river health.	Boating, Fish and Fishing, Tourism - Other Recreation, Water and Irrigation, Farming, Other Economic
8	Difference caused because of dams on natural flow.	Environmental flows
9	Mapping of impact of flooding of river. Social and economic impact of failure to address flood mitigation.	Flooding, Funding
10	Lack of stabilisation of the river bank eg trees and natural vegetation.	Erosion, Biodiversity
11	Impact of recreational boating on river bank erosion.	Boating, Tourism - Other Recreation

Table 6

#	Problem	Categories
1	Lack of a single independent river authority reporting to one single (senior) minister. Lack of a cohesive plan.	Institutional - Management, Funding, Skills - Resources, Compliance
2	Land management practices	Water quality, Stormwater, Sewerage, Erosion, Weeds, Population Pressure, Flooding, Tourism - Other Recreation, Water and Irrigation, Farming, Access
3	Urban development & land clearance in the catchment	Water quality, Stormwater, Sewerage, Erosion, Weeds, Population Pressure, Biodiversity, Flooding, Environmental flows, Water and Irrigation
4	Poor water quality - due to effluent and runoff	Water quality, Stormwater, Sewerage, Erosion, Weeds, Biodiversity, Environmental flows, Boating, Fish and Fishing, Tourism - Other Recreation, Water and Irrigation, Farming, Other Economic, Compliance
5	Restricted flow - lack of natural flow	Water quality, Population Pressure, Environmental flows, Fish and Fishing, Water and Irrigation, Farming, Other Economic, Awareness and Education
6	Small order streams contributing a high portion of problems	Water quality, Erosion, Weeds, Biodiversity, Water and Irrigation, Farming

#	Problem	Categories
7	Man made problems - water quality - these are all able to be rectified	Water quality, Stormwater, Sewerage, Erosion, Weeds, Population Pressure, Biodiversity, Flooding, Environmental flows, Boating, Fish and Fishing, Tourism - Other Recreation, Water and Irrigation, Farming, Other Economic, Access, Institutional - Management, Funding, Skills - Resources, Monitoring, Awareness and Education, Compliance, Community Division
8	Introduced species - flora & fauna	Water quality, Erosion, Weeds, Biodiversity, Boating, Fish and Fishing, Tourism - Other Recreation, Water and Irrigation, Farming, Other Economic, Awareness and Education
9	Bank degradation - siltation	Water quality, Erosion, Weeds, Biodiversity, Flooding, Boating, Fish and Fishing, Tourism - Other Recreation, Farming, Other Economic, Access
10	Lack of action - all talk no action	Institutional - Management, Funding, Skills - Resources, Monitoring, Awareness and Education, Compliance, Community Division
11	Lack of monitoring	Water quality, Stormwater, Sewerage, Institutional - Management, Funding, Skills - Resources, Monitoring, Awareness and Education, Compliance
12	A need for and establishment of riparian corridors as part of an LEP - protection	Water quality, Erosion, Weeds, Biodiversity, Flooding, Funding, Compliance
13	A lack of public awareness of the river flows in regards to fresh water flows being replaced by recycled water flows	Water quality, Sewerage, Population Pressure, Institutional - Management, Monitoring, Awareness and Education

#	Problem	Categories
14	Overall (lack of) depth of the navigation channel of the Hawkesbury -- from Windsor to the sea	Erosion, Climate Change, Flooding, Environmental flows, Boating, Fish and Fishing, Tourism - Other Recreation, Water and Irrigation, Farming, Other Economic, Institutional - Management, Compliance, Community Division
15	Dedicated funding source with set goals and a set duration	Institutional - Management, Funding, Skills - Resources, Monitoring
16	Lack of environmental scientist in Local Government	Institutional - Management, Funding, Skills - Resources, Monitoring, Awareness and Education, Compliance
17	Lack of access to river	Population Pressure, Boating, Fish and Fishing, Tourism - Other Recreation

Table 7

#	Problem	Categories
1	Depleted natural flows/dams/STPs	Environmental flows
2	Water quality - STPs etc. Stratification issues.	Water quality, Sewerage
3	Aquatic weed, pest species (fish).	Water quality, Weeds, Fish and Fishing, Institutional - Management
4	Altered hydrology (urban impact)-storm water nutrients, run off, peak discharge increased, rubbish, phosphates.	Stormwater, Sewerage, Population Pressure, Climate Change, Flooding, Institutional - Management
5	Changing land use patterns - urban development	Population Pressure, Farming, Other Economic, Institutional - Management
6	Lack of coordinated development control, river bank structures (pontoons, wharves etc)	Institutional - Management
7	River bank erosion. Lack of quality of riparian vegetation, canal style development (landscaping by owners). Live stock access.	Flooding, Farming, Institutional - Management, Awareness and Education, Other
8	Lack of education for community	Sewerage, Awareness and Education
9	Siltation/sedimentation	Erosion, Water and Irrigation, Institutional - Management, Funding
10	Dredging/extraction	Erosion, Environmental flows, Boating, Institutional - Management
11	Air quality /spreading of poultry manure - only affects the river if run off enters the river.	Water quality, Stormwater, Tourism - Other Recreation, Farming, Institutional - Management

#	Problem	Categories
12	Maintaining access for irrigation - impact on pumps from siltation/weeds	Water and Irrigation, Farming, Access
13	Current lack of water sharing plan	Institutional - Management
14	Proliferation of basic landholder rights (water rights)	Population Pressure, Water and Irrigation, Farming, Institutional - Management, Monitoring
15	Too many fish barriers.	Biodiversity, Environmental flows, Fish and Fishing, Water and Irrigation

Table 8

#	Problem	Categories
1	Three tiers of government approach to management with lack of central agency or body for responsibility	Institutional - Management, Funding
2	Increased nutrients in the river due to sewage, urban stormwater and agricultural run off	Water quality, Stormwater, Sewerage, Population Pressure
3	Almost nil environmental flows	Environmental flows, Compliance
4	Terrestrial and aquatic weeds and algae	Water quality, Stormwater, Sewerage, Weeds, Climate Change, Farming
5	Increased bank degradation and erosion due to lack of appropriate vegetation and changing and increased recreational activity	Erosion, Population Pressure, Climate Change, Boating, Tourism - Other Recreation, Farming
6	Flooding and lack of mitigation to reduce flood levels to protect life, property, infrastructure	Climate Change, Flooding, Awareness and Education, Compliance
7	Changing hydrology of river eg dredging, siltation	Stormwater, Erosion, Population Pressure, Climate Change, Flooding, Environmental flows, Farming
8	Impacts on the local fishing industry - which reduces usable catches	Water quality, Stormwater, Weeds, Population Pressure, Climate Change, Boating, Fish and Fishing, Tourism - Other Recreation, Compliance
9	Degradation of estuarine wetlands	Water quality, Weeds, Population Pressure, Climate Change, Biodiversity, Environmental flows

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