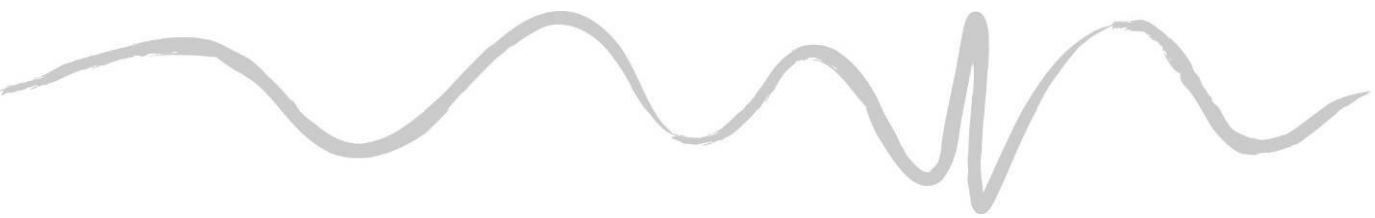
# Macleay River Estuary

## Estuary Management Study



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# Macleay River Estuary

## Estuary Management Study

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***GECO Environmental***

AQUATIC SCIENCE AND MANAGEMENT

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# Executive Summary

Kempsey Shire Council, through its Coast & Estuary Management Committee has resolved to prepare an Estuary Management Plan (EMP) in accordance with States Estuary Program for the Macleay River estuary (the lower Macleay River, its tributaries and associated floodplain).

The purpose of an EMP is to provide a program of strategic actions and assist with funding for council, government authorities and other stakeholder groups to improve the Macleay River estuary through appropriate waterway, foreshore and catchment management initiatives.

The precursor to an EMP is preparation of an Estuary Management Study (EMS). The EMS is supported by a number of studies and assessments specific to Macleay River Esturary and includes:

- data compilation;
- tidal gauging;
- processes study; and
- ecology study.

The EMS identifies estuary values, uses, issues, management objectives and an initial set of management strategies with the aim of improving the health of the estuary and providing for the various uses of the estuary such as boating and fishing.

The study area for the Macleay River estuary covers the floodplain and includes the main regional town of Kempsey, in addition to the smaller towns of Frederickton, Smithtown, Kinchella, Jerseyville, Stuarts Point, Fishermans Reach and South West Rocks. The Macleay River estuary extends some 54 kilometres upstream from the ocean at South West Rocks to the tidal limit at Belgrave Falls about 10 km upstream of Kempsey. The study area also includes Back Creek (South West Rocks Creek). While the Macleay River is the dominant watercourse on the floodplain, significant tributaries include Christmas, Borirgalla and Clybucca Creeks, Macleay Arm to the north and Belmore River and Kinchela Creek to the south.

**A Snapshot of the Estuary's Values and Issues**

The Macleay River estuary with a catchment of 11,000 km$^2$ is the regions second largest coastal river linking the tablelands of Armidale, gorge country and big valley to the ocean at South West Rocks.

The Macleay River estuary provides significant recreational boating opportunities that in turn form a vital component of the tourism sector of the lower Macleay River Valley and a significant lifestyle activity enjoyed by a large proportion of the community. Availability of suitable river access points and appropriate and complimentary marine infrastructure is critical to the enjoyment of recreation boating in the estuary.

There are also significant levels of commercial and recreational fishing activities and oyster farming in the Macleay River estuary. Outside the estuary, trawlers catch fish and prawns, many of which are

ecologically linked to the estuary. Recreational fishing is widespread and the Macleay River is acknowledged as providing important habitat for Australian Bass, a significant recreational species.

The floodplain of the Macleay River estuary includes large backswamps (or floodplain wetlands) that cover 60% of the floodplain and are intrinsically connected to estuarine health. The Macleay floodplain holds approximately 15% of the coastal floodplain wetlands in NSW (Kingsford et al. 2003). While the estuary contains significant environmental attributes, less than 5% of the Macleay River floodplain is under environmental protection or existing/proposed national parks estate zonings (Birch and GeoLINK 2010).

The entire floodplain is underlain by estuarine soils that include acid sulfate soils. Since the early 1900s the Macleay floodplain has been extensively modified with the construction of floodgates, drains and levees which has had a detrimental impact on floodplain wetlands, acid sulfate soil management and water quality. Kempsey Shire Council in association with individual landholders, community-based organisations and government agencies has been addressing floodgate and drain management issues since 2000. Projects have included actively managing floodgates with an opening protocol, floodgate modification or other methods to achieve multiple objectives of improving drain water quality, enhanced fish passage, maintaining agricultural production and flood mitigation functions.

**The Main Issues and Focus Areas**

The EMS has examined the following key issues and values relating to the Macleay River estuary:

- Riparian corridor which contains some high value ecosystems that occur within the Macleay River estuary but are highly degraded and fragmented;
- Bank erosion: there is a high correlation between the presence/absence of bank erosion and absence/presence of structurally diverse native riparian vegetation outside the areas where rock bank protection works have been implemented;
- Floodplain wetlands which are intrinsically connected to estuarine ecology and health but have been significantly altered in the Macleay estuary due to land clearing, drainage and flood mitigation works;
- Acid sulfate soils – the entire floodplain is underlain by estuarine soils that include acid sulfate soils. Exposure of acid sulfate soils which has led to water quality issues, reduction in agricultural productivity, and loss of estuarine habitat. There is a history of fish kills that usually occur after heavy rains following prolonged dry periods.
- Drains and floodgate management which impacts on floodplain wetlands, acid sulfate soil management and water quality;
- Boating in respect to river access points and boating infrastructure;
- Sedimentation and dredging particularly in relation to boating navigation of waterways in the estuary;
- Tourism to identify opportunities in respect to the range of estuary values and uses;
- Protection of ecological habitats and wildlife such as remaining rainforest pockets, wetlands, black cod and migratory shorebirds;
- Fishery management to address key issues impacting on oyster farming and recreational and commercial fishing concerns;
- Water quality such as 'blackwater' discharges following floods and other pollution concerns;
- Climate change impacts on the estuary particularly in regard to sea level rise; and
- Heritage issues: Aboriginal and European heritage to ensure consistency between the EMP and heritage strategies in the region.

**Estuary Management Priorities**

The table overleaf shows the ranked management objectives that have been developed following assessment of the above issues and values. The ranking relates to priority for management over the next five to ten years which is the expected planning timeframe for the Macleay River Estuary Management Plan before it undergoes review and adjustment. The ranked management objectives generally show that improved management of floodplain wetlands, floodgates and drains, and water quality improvements are

the key management objectives for the Macleay River estuary. Other objectives involve improved boating facilities, planning for sea level rise on the low-lying floodplain, implementing bank erosion works at key locations, and improving the condition of the riparian corridor.

**Ranked Estuary Management Objectives for 2011 to 2016**

| *Ranking* | *Estuary Management Objective* |
|---|---|
| 1 | Acknowledge sea level rise and climate change within the landuse planning framework |
| 2 | Improved export water quality from floodplain wetland areas |
| 3 | Coordinate and prioritise drainage projects |
| 4 | Pursue active water management of floodgates in non-flood periods |
| 5 | Conservation of representative areas of floodplain wetlands |
| 6 | Maximise opportunities for public access to the Macleay River from commercial areas and the public domain within riverside townships |
| 7 | Reduce the occurrence of black water discharge from floodplain wetlands |
| 8 | Investigate water management improvements in the Collombatti-Clybucca drainage scheme |
| 9 | Plan for appropriate landuse of floodplain and backswamps susceptible to sea level rise |
| 10 | Improved water retention in floodplain wetlands |
| 11 | Utilise best-practice erosion control, riparian management techniques and flood mit. works |
| 12 | Reconnect the built form and public domain of riverside townships with the Macleay River |
| 13 | Improve the fishery productivity of the Macleay River estuary system |
| 14 | Develop a clear floodgate management regime for flood and non-flood events |
| 15 | Manage Yarrahapinni floodgates in accordance with Yarrahapinni Wetlands National Park Plan of Management. |
| 16 | Protect and manage important habitat areas |
| 17 | Protect important riparian conservation areas where threatened by bank erosion, weed invasion, or land management practices |
| 18 | Manage recreational boat use in areas susceptible to boat wash erosion |
| 19 | Preparation of a strategic plan for the future management of floodplain wetlands |
| 20 | Improved boating access and infrastructure |
| 21 | Improve the condition and continuity of the riparian corridor |
| 22 | Reduce the incidence of fish kills and oyster mortality related to poor water quality from floodplain wetland areas |
| 23 | Clarify the protocol for oyster mortality events on the Macleay River |
| 24 | Improve the water quality in regard to chlorophyll a and suspended sediment |
| 25 | Reduce the sediment load from diffuse sources and erosion |
| 26 | Develop a water quality monitoring program in regard to estuary health |
| 27 | Identify high priority conservation value habitats |
| 28 | Protect existing public infrastructure threatened by bank erosion |
| 29 | Improved understanding of the connection between the floodplain wetlands and estuary health |
| 30 | Protect existing bank and riparian management works |
| 31 | Ensure EMS strategies do not conflict with heritage objectives |
| 32 | Consider commercial fisher needs in the planning approval process for boating infrastructure |
| 33 | Reduce nutrient loads from Sewage Treatment Plants and diffuse sources |
| 34 | Protect and manage migratory and threatened birds (particularly shorebirds). |
| 35 | Control of *Salvinia molesta* on wetlands and in drains; |
| 36 | Minimise sediment loads that impact upon estuarine habitat and reduce water quality |
| 37 | Improve community understanding of safety issues with crossing entrance bars |
| 38 | Increase the local population of black cod |
| 39 | Develop and implement a comprehensive monitoring and reporting program to improve the understanding of the ecological health of the Macleay River estuary; |
| 40 | Reduce the risk and eyesore associated with derelict oyster leases; |
| 41 | Continue sampling that contributes to the NSW MER reporting requirements; |
| 42 | Future pedestrian / cycle paths in the Macleay Arm area |
| 43 | Develop a maintenance dredging protocol to address boating navigation concerns in Macleay Arm and at Riverside Park at Kempsey |
| 44 | Develop an entrance management protocol for boating navigation at Back Creek entrance |

# 1 Introduction

The many estuaries of NSW are of great environmental, social and economic importance. Estuaries are calculated to contribute about $400 million to the NSW economy through ecosystem services, food chain contributions and tourism and development (DWE, 2008).

The management of estuaries has developed in line with the increasing pressures on estuaries and coastal areas in general. Habitat degradation, water quality issues, loss of amenity and access restrictions are some of the estuary related issues confronting coastal communities and their councils.

Because of it commercial and recreational value, the Macleay River estuary (Macleay estuary) is a principal feature of the NSW mid north coast region. Past flood mitigation works combined with increases in population, tourism, commercial and recreational activities are placing pressures on the natural processes, health and integrity of this estuary, its coastal floodplain and its foreshores.

In recognition of the above, Kempsey Shire Council, through its Coast & Estuary Management Committee has resolved to prepare an Estuary Management Plan (EMP) for the Macleay estuary. The procedure for developing an EMP as set under the NSW Government Estuary Management Program involves the following eight step process:

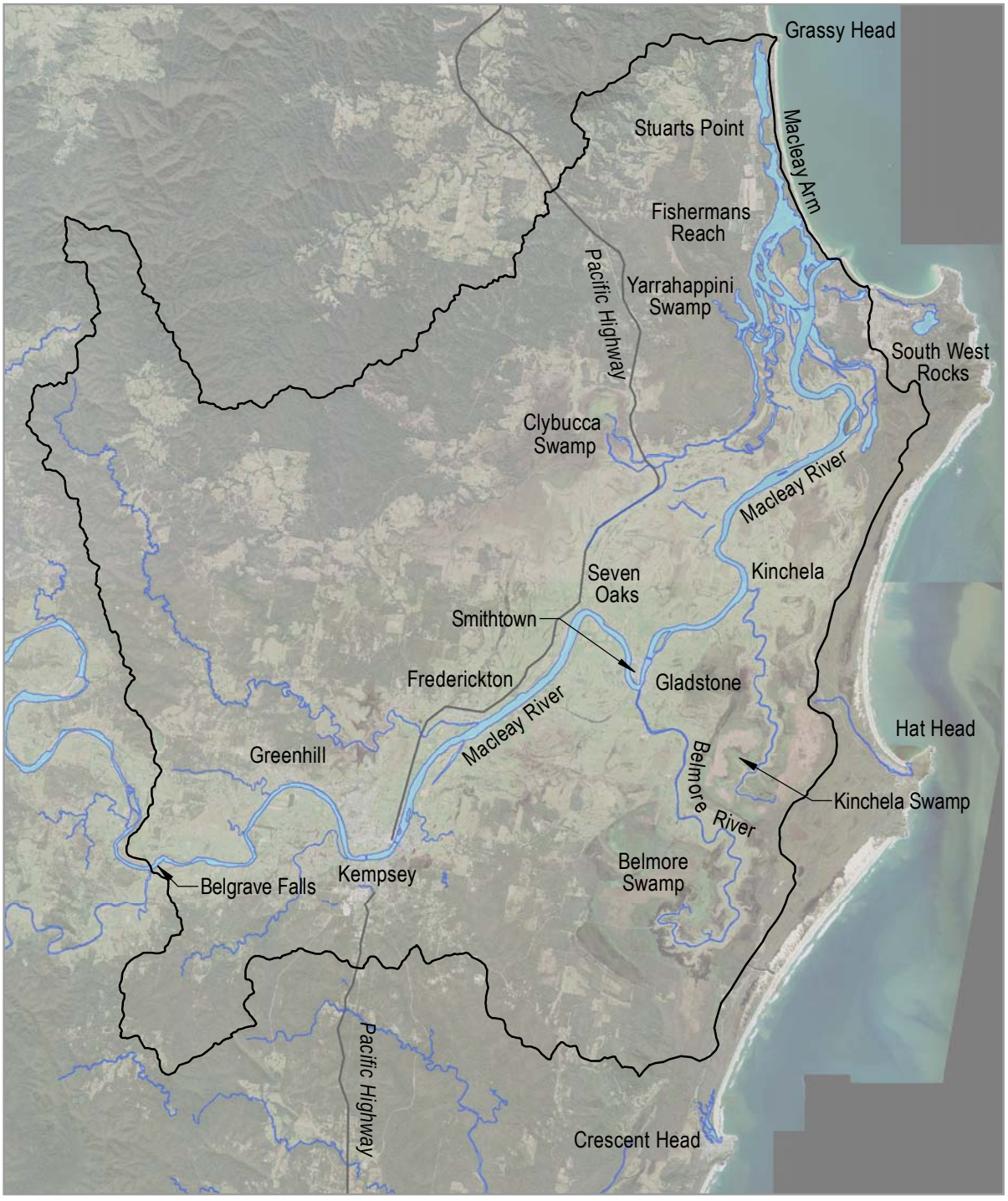
1. Form an Estuary Management Committee
2. Identify issues and set goals
3. Assemble existing data
4. Carry out an Estuary Process Study
5. **Carry out an Estuary Management Study**
6. **Prepare and review the Estuary Management Plan**
7. Adopt and implement the Estuary Management Plan
8. Monitor and review the management process

Kempsey Shire Council has met the requirements of steps 1 through 4 of this process. This study, the Macleay River Estuary Management Study addresses step 5. It will precede the development of an Estuary Management Plan. The final Estuary Management Plan is expected to remain current for a 5 year planning timeframe before requiring review.

The study area includes the Macleay River estuary and its coastal floodplain. This includes the waterways and all tributaries up to the tidal limit, the entrance, foreshores, floodplain and adjacent land including towns, and the coastline. The study area also includes Back Creek (South West Rocks Creek). The extent of the Macleay estuary study area is shown in **Illustration 1.1**.

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*




LEGEND

Study area
Watercourse / waterbody

North

0 5 km

# Study Area

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352468

Illustration 1.1

## 1.1 Aims of the Macleay River Estuary Management Study

The main aims of the Macleay River Estuary Management Study are to:

- identify estuary values, uses, issues and management objectives based on community and stakeholder consultation and review of the findings of the Data Compilation study and Processes Study and other relevant literature, strategies and policies;
- identify critical processes and threats to the estuary;
- identify and describe the management issues affecting the Macleay estuary including those identified through the previous estuary process steps and through community and stakeholder consultations; and
- develop a prioritised list of the estuary management issues including the identification of potential management strategies for consideration and further refinement during the formulation of the Macleay River Estuary Management Plan.

## 1.2 Report Structure

This report is structured in the following manner:

| | |
|---|---|
| Section 1 | ***Introduction***<br>Describes the study area and outlines the statutory framework for estuary management in NSW including the various legislative, policy, and planning instruments that apply to the Macleay River Estuary Management Plan |
| Section 2 | ***Estuary Values***<br>Presents a summary of the outcomes of community and stakeholder consultations and an overview of estuary values, uses of the estuary, and issues derived from the consultation and literature review |
| Sections 3 to 16 | ***Estuary Issues***<br>These sections address each of the identified issue topics for the Macleay estuary including an overview of the current status of the topic, and associated management issues, objectives and proposed management strategies. The issue topics comprise: riparian management and erosion; floodplain wetlands management; acid sulfate soils; floodgates and drain management; boating; sedimentation and dredging; tourism; habitat protection; fishery management; threatened species; water quality; climate change; heritage; and estuary health. |
| Section 17 | ***Summary of Management Strategies***<br>Summaries the proposed management strategies from the previous sections |

## 1.3 Background

The Coast and Estuary Management Committee was established by Kempsey Shire Council in 1997 to prepare management plans for the estuaries and coastal lands within Kempsey Shire local government area. Estuary Management Plans are prepared under the guidance of the NSW Coastal Policy 1997, the Estuary Management Manual (1992), and the North Coast Rivers Healthy Rivers Commission Report (HRC 2003). The process to date has been jointly funded by Council with assistance from States Estuary Program administered by DECCW.

Previous studies and surveys commissioned for the Macleay estuary as part of the estuary planning process include:

- Data compilation study (GECO 2005);
- Full Hydrographical Survey (Dept Commerce May 2003);
- Tidal Gauging Hydrosurvey (MHL Sept 2003);
- Macleay River Estuary Processes Study (WMAWater Jan 2009);
- Coastal Lake Assessment and Management (CLAM) Back Creek South West Rocks Sustainability Assessment Report (Jun 2007);
- Macleay River Estuary Ecological Study (Birch and GeoLINK, study in progress); and
- Macleay River Marine Infrastructure Assessment (GeoLINK, study in progress)

## 1.4 Macleay River Estuary Study Area

The Macleay River is located approximately 340 km north of Sydney on the Mid North Coast of NSW and has a catchment area of 11,435 km². The catchment extends to the tablelands of Armidale, gorge country and big valley to the ocean at South West Rocks. The Macleay River estuary covers an area of 739km² including the main regional town of Kempsey, in addition to the smaller towns of Frederickton, Smithtown, Kinchella, Jerseyville and South West Rocks. The Macleay River estuary extends some 54 kilometres upstream from the ocean at South West Rocks to the tidal limit at Belgrave Falls about 10km upstream of Kempsey.

The coastal floodplain has an area of 400 km² and includes well defined levees up to seven metres above mean sea level along the rivers and creeks below Kempsey, grading to large semi permanent backswamps often less than one metre above mean sea level (M.Tulau & S. Naylor 1999). These swamps cover some 240 km² representing 60% of the floodplain. The Macleay floodplain holds approximately 15% of the coastal floodplain wetlands in NSW (Kingsford et al. 2003).

The entire floodplain from Kempsey to South West Rocks is underlain by extensive estuarine deposits that include potential and actual Acid Sulfate Soil (ASS). It is estimated that some 310 km² of floodplain downstream of Kempsey is underlain by high risk ASS that is either at or near the surface.

Extensive flood mitigation works initiated after the 1949 and 1950 floods have significantly modified the coastal floodplain with some 210 floodgates in 47 separate structures servicing some 116km of excavated drains, 180km of levees. A large proportion of the Macleay River banks downstream of Kempsey are lined with rock protection works (M. Tulau & S. Naylor 1999).

While the Macleay River is the dominant watercourse on the floodplain, significant tributaries include Christmas, Borirgalla and Clybucca Creeks, Macleay Arm, Andersons Inlet to the north and Belmore River and Kinchela Creek to the south. The Macleay River enters the ocean through a trained river entrance located approximately 1.6 km north of South West Rocks. Previously the river entered the ocean at Grassy Head. The change in entrance location occurred during a large flood in 1893 when floodwaters broke through to the ocean at the present entrance location. The new entrance channel was dredged and training walls were constructed by 1897. The old river channel between South West Rocks and Grassy Head is now a backwater known as the Macleay Arm.

The mangroves area on the Macleay cover an area of about 5 km² representing 5% of the State's estuarine remaining total mangrove forest total area, while seagrass and saltmarsh areas cover 1.1 km² and 3.7 km² respectively of the estuary (West, *et al*, 1985). The majority (>80%) of the seagrass in the Macleay is found in the Macleay Arm between Shark Island and Grassy Head. The majority (>60%) of the saltmarsh occurs as extensive fields of marine rush and salt couch in the Clybucca Creek / Andersons Inlet area.

While the Macleay River estuary contains significant environmental attributes, less than 5% of the Macleay River floodplain is under environmental protection or existing/proposed national parks estate zonings (Birch and GeoLINK 2010).

The Macleay River "riparian corridor" is highly degraded due to the extent of clearing and the scarcity of remnant pockets along the riparian margin and across the floodplain. Weed infestation is extensive (ID Landscape Management 2005). Extensive backswamp areas now have little productivity as many of the water tolerant species are now replaced by less tolerant pasture species. There is a history of fish kills that usually occur after heavy rains following prolonged dry periods. (S. Naylor 1996)

The Lower Macleay provides significant recreational boating opportunities with abundant diversity of waterways fronting the New Entrance area of South West Rocks.

There are significant levels of commercial and recreational fishing activities and oyster farming in the lower Macleay. Outside the estuary, trawlers catch fish and prawns, many of which are ecologically linked to the estuary. Recreational fishing is widespread with fish being sought in similar areas to commercial fishermen. The Macleay is also acknowledged as providing important habitat for Australian Bass, a significant recreational species. (Webb 1997)

The Macleay estuary is a filled delta system dominated by fluvial processes. It can be divided into three broad process zones that reflect differing degrees of fluvial and tidal interactions. Marine flood tide zone is dominated by marine derived sediment and extends upstream from the mouth of the Macleay River to Jerseyville Bridge including the Macleay Arm. The fluvial- marine transitional zone extends from Jerseyville Bridge upstream to Kinchela and includes most of Clybucca Creek. The larger fluvial zone extends from Kinchela to the study limit at the tidal limit at Belgrave Falls. This zone includes Belmore, Kinchela and Upper Clybucca Creek (Cohen Sept 2005).

Some of the mapping used in this report is broadly based on these process zones. Due to the large area covered in the EMS study, mapping of the study area has often been divided in the following three sub-regions (refer to **Illustrations 1.2, 1.3 and 1.4**):

- Sub-region A Macleay Arm and Entrance Marine process
- Sub-region B Middle Reach – Gladstone/Smithtown Transitional process
- Sub-region C Upper Reach – Kempsey Fluvial process

## 1.5 Planning Framework

A planning framework outlining the planning instruments, policies and management plans relevant to the development and management of Estuary Management Plans is attached in full at **Appendix D** and outlined below.

### 1.5.1 NSW Estuary Management Process

The development and implementation of Estuary Management Plans is overseen by Estuary Management Committees established by Kempsey Shire Council. An estuary management plan is developed through the NSW Estuary Management Policy 1992 and NSW Coastal Policy 1997. In addition, a range of NSW legislation and policies are also relevant.

NSW Estuary Management Policy 1992 is a State Government initiative aimed at managing the increasing pressures on estuarine systems. The introduction of this policy meant that the then Department of Public Works (now Department of Environment, Climate Change and Water) in partnership with local Councils was responsible for the preparation of Estuary Management Plans. The aim of this policy was to ensure

estuaries were ecologically sustainable while allowing estuaries to be used in a manner which facilitated social and economic gain.

The NSW Coastal Policy 1997 deals with population and economic growth whilst protecting the natural, cultural, heritage and spiritual values of the coastal environment. The policy has a strong focus on the principles of Ecologically Sustainable Development (ESD).

The NSW Coastal Policy 1997 acknowledges that the management of coastal zones is the responsibility of State and Local governments as well as the community. The Macleay River and its foreshores fall within the defined coastal zone, therefore the coastal policy needs to be considered in the preparation of the Macleay Estuary Management Plan. Councils are required to implement the policy when making local environmental plans applying to land within the coastal zone and to take the provisions of the policy into consideration when determining development applications in the coastal zone.

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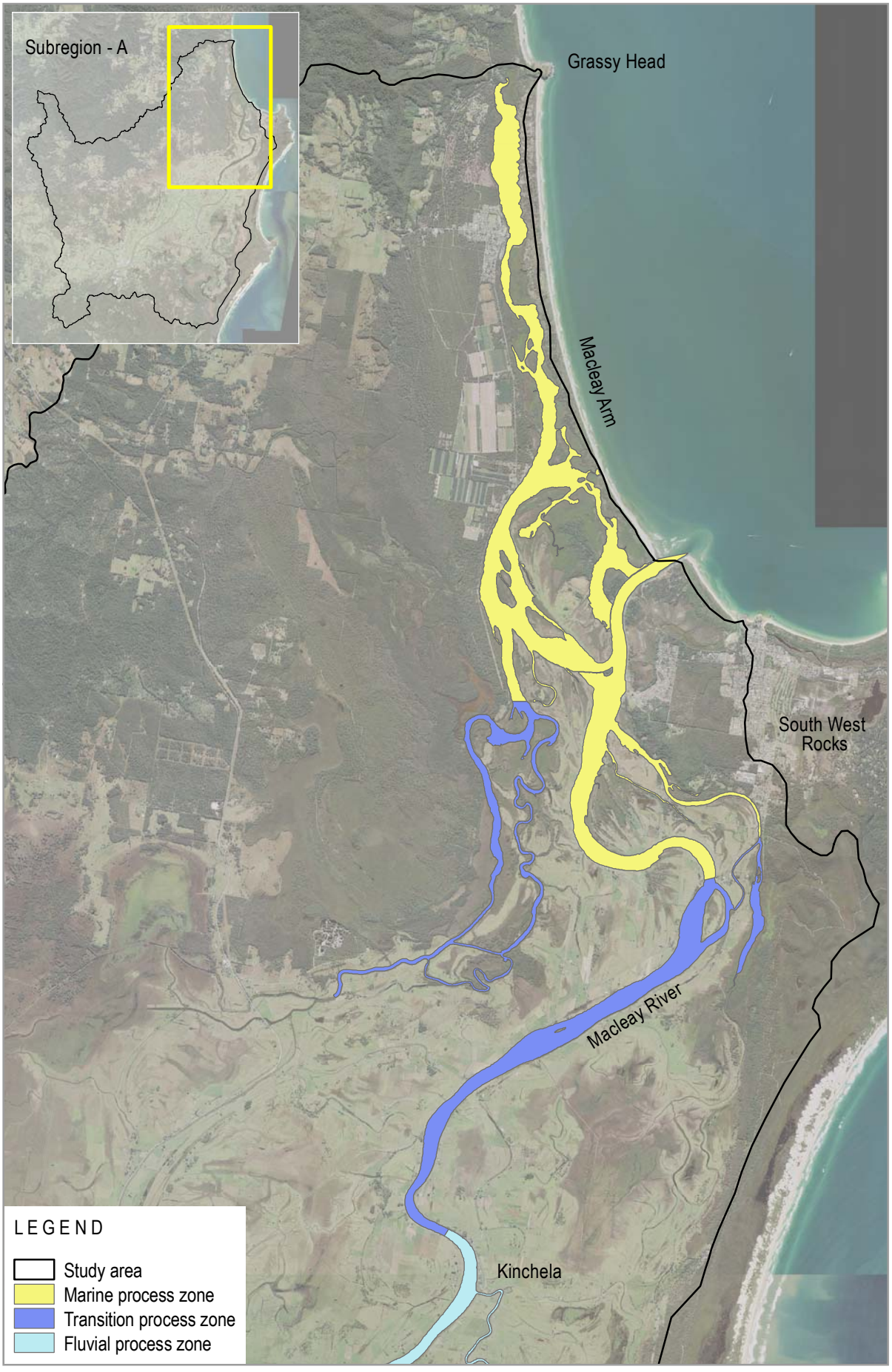
*Source of base data: Kempsey Shire Council*




0 2 km

North

# Estuary Process Zones - Subregion A

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Macleay River Estuary Management Study
1352754

Illustration 1.2

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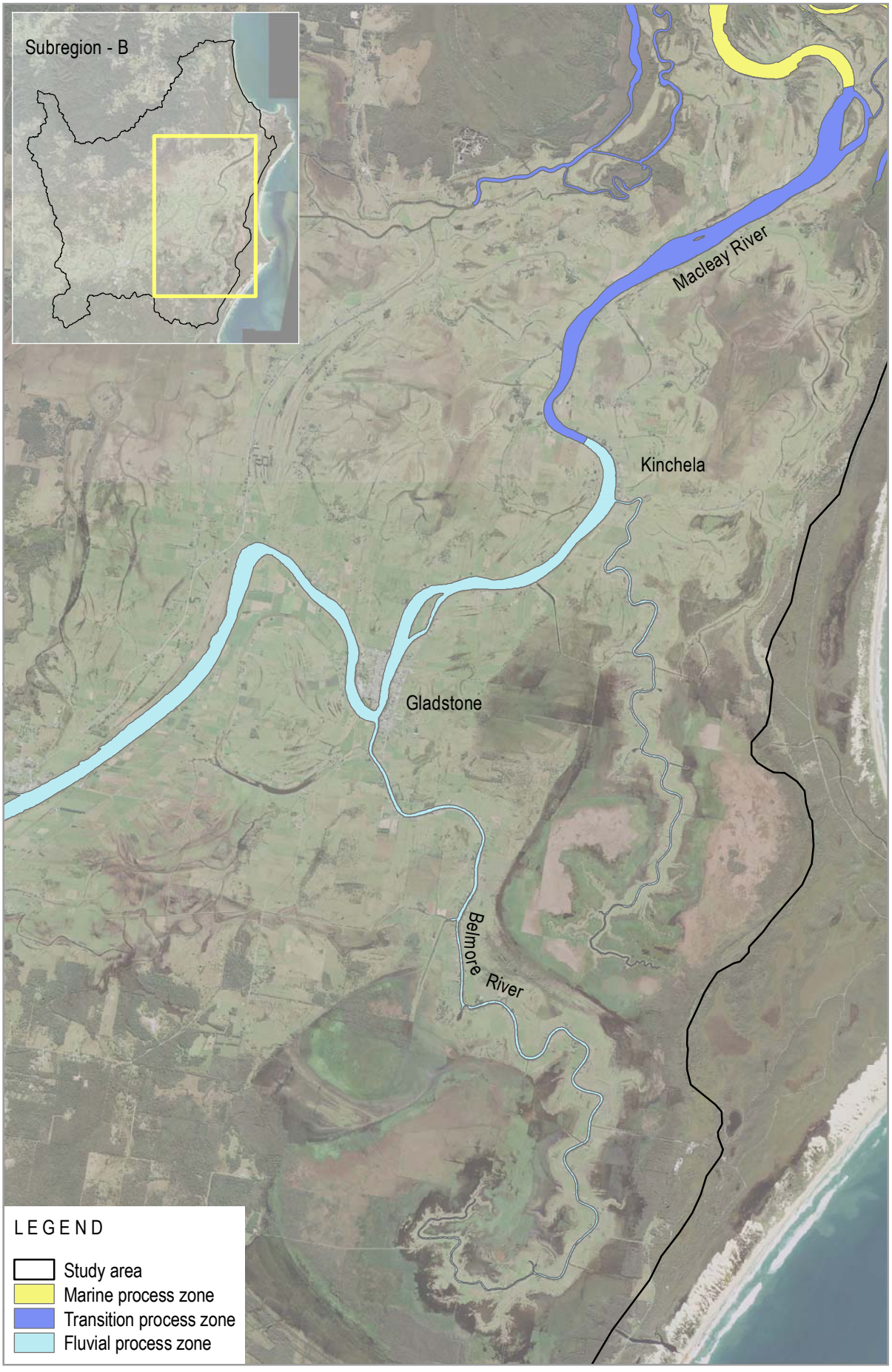


0 2 km

North

# Estuary Process Zones - Subregion B

*Information shown is for illustrative purposes only*

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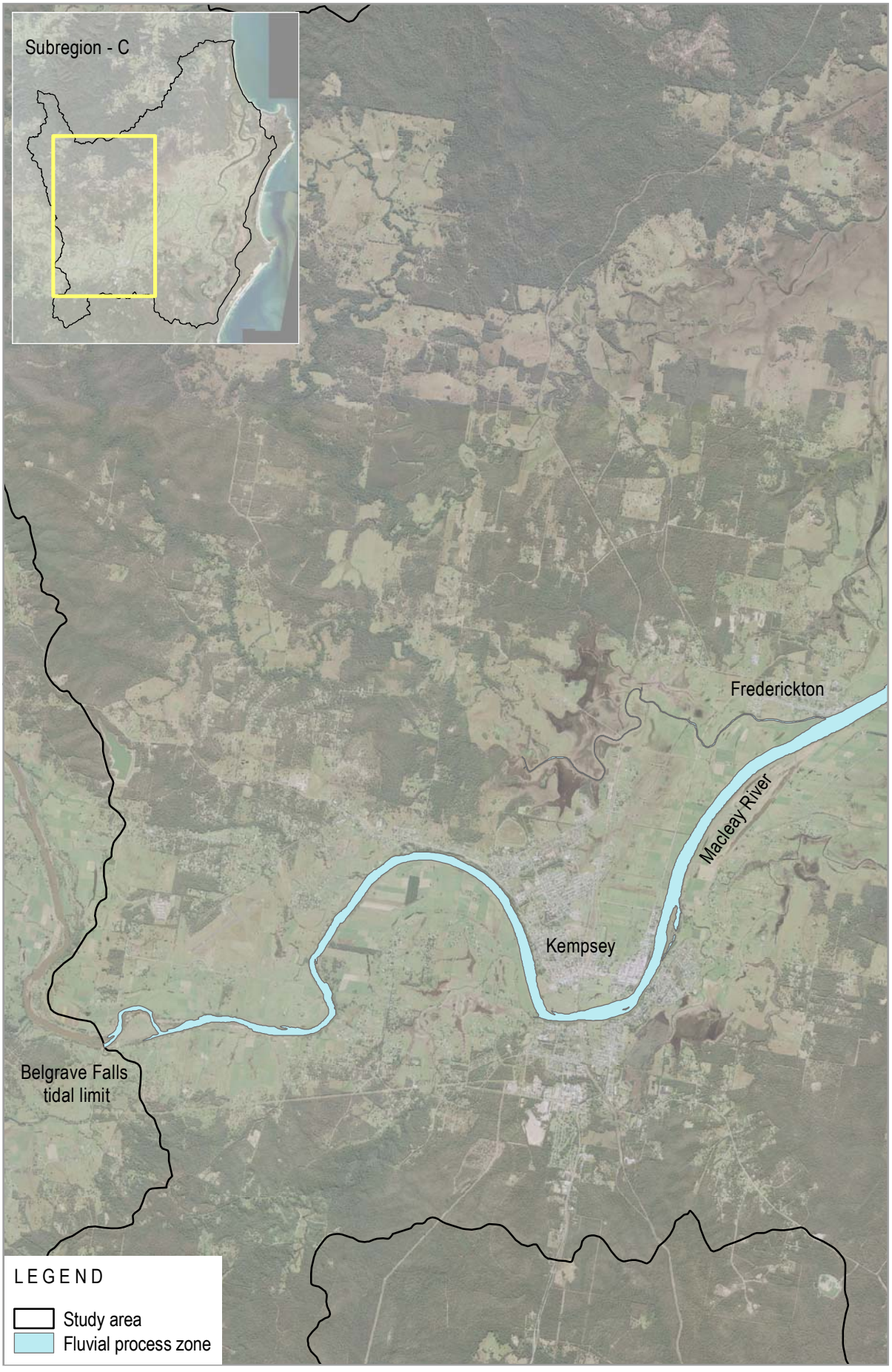
*Source of base data: Kempsey Shire Council*




North

0 2 km

# Estuary Process Zones - Subregion C

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Macleay River Estuary Management Study
1352756

Illustration 1.4

### 1.5.2 NSW Government and Regional Framework

The following legislative and policy frameworks apply to estuary management in NSW:

- Coastal Protection Act 1979;
- Environmental Planning and Assessment Act 1979 (including State Environmental Planning Policies);
- Threatened Species Conservation Act 1995;
- National Parks and Wildlife Act 1974;
- Fisheries Management Act 1994;
- Protection of the Environment Operations Act 1997;
- Native Vegetation Act 2003;
- Catchment Management Authorities Act 2003;
- Heritage Act 1977;
- Noxious Weeds Act 1993;
- Protection of the Environment Administration Act 1991;
- Other relevant Acts:
  - Natural Resources Commission Act 2003;
  - Crown Lands Act 1989;
  - Local Government Act 1993; and
  - Environment Protection and Biodiversity Conservation Act (Commonwealth) 1999.

The following Government Policies apply to the Macleay River:

- NSW Government Sea Level Rise Policy Statement (Draft);
- DoP Planning Guidelines;
- NSW State Plan 2006;
- North Coast Rivers – March 2003;
- Healthy Rivers Commission – Independent Inquiry into Coastal Lakes 2002; and
- Rivers of Tomorrow – November 2003.

### 1.5.3 Council Planning Framework

The following Kempsey Shire Council planning documents apply to the Macleay River Estuary Management Plan

- Kempsey LEP 1987;
- Kempsey Local Government Development Control Plans;
- Kempsey Shire Ecologically Sustainable Development Strategy; and
- Kempsey Integrated Water Cycle Management Study.

Kempsey Shire Council has prepared a draft LEP consistent with the Standard Instrument – Principal Local Environmental Plan (SLEP). The draft LEP is currently being reviewed by NSW Department of Planning and is due for public exhibition in early 2011. The new LEP will be gazetted by June 2011.

# 2 Estuary Values

This section aims to identify and analyse the key values and issues that define the Macleay estuary. An important element of this process is the contribution of the local community and stakeholders in providing an understanding of:

- important estuary uses;
- the different values the community and stakeholders derive from the estuary;
- issues with uses and values of the estuary; and
- community and stakeholder aspirations for those uses and values.

## 2.1 Community and Stakeholder Consultation

Community and stakeholder input to this study has been sought in a number of ways including:

- **Community Meetings:**
  An initial round of open public meetings was held at Stuarts Point, South West Rocks and Kempsey in September / October 2009 near close to the commencement of the study. The purpose of the meetings was to inform the community of the general objectives and scope of the study and to obtain initial input on community values, uses, issues and objectives for the estuary;
  A second round of open public meetings will be held at Stuarts Point, South West Rocks and Kempsey in June / July 2010 to discuss and prioritise management objectives identified in the draft EMS;
- **Community Survey:**
  A general survey and boating survey was conducted over a two month period from 21 December 2009 to 5 February 2010. The surveys comprised a questionnaire to gain further feedback on values, uses, issues and objectives for the estuary and specific information on boating in the estuary;
- **Comment on Draft Documents:**
  An initial draft of the Estuary Management Study report has been provided to members of the Coast and Estuary Management Committee for comment. The comments have been incorporated into this final draft;
- **Community working groups:**
  volunteers from the initial round of open public meetings will assist in the role of an information 'conduit' between the GeoLINK team and the local communities over the duration of the project.;
- **Media releases:**
  media releases articles advising the general public of each round of the open public meetings, the availability of the community survey, and the release of the Draft Estuary Management Study have run appeared in local papers over the course of the study;

### 2.1.1 Initial Round of Community Meetings

The venues for the public meetings have been selected based on three 'community-scale' catchments to better address local issues:

1. **Stuarts Point**: to cover the Grassy Head / Stuarts Point / Fishermans Reach / Clybucca area (covering the Macleay Arm area and the Borirgalla and Clybucca Creek areas);
2. **South West Rocks**: to cover the South West Rocks / Jerseyville area (covering the entrance and Back Creek); and

3. **Kempsey**: to cover the Kinchella / Gladstone / Smithtown / Frederickton / Kempsey / Belmore River area (covering the agricultural floodplains and upper reaches of the study area).

The purpose of the initial meetings was to gain input from the community in regard to their values, issues and objectives for the Macleay estuary. The meetings were held on weekday evenings. The initial round of community meetings attracted only a small number of participants. However those present at the meetings offered plenty of significant feedback on different issues. A full summary of the input is provided in **Appendix E**. The main points are summarised below.

#### *2.1.1.1 Community Values Expressed at Initial Public Meeting*

The main aspects of the Macleay estuary valued by participants included (in no specific order):

- **Back Creek**: considered a valuable location for its amenity and as a tourist attraction;
- **Riparian vegetation** and the ecological attributes of the Macleay Arm are considered to have a high value compared to southern areas of the estuary;
- **Recreational fishing**: was commented on by a large number of participants. Valued aspects of recreational fishing included Bass fishing, Golden Hole location near the entrance to Yarrahapinni wetlands, fishing competitions, tourism attraction associated with fishing in the estuary, and the ability to access ocean fishing in close proximity to the continental shelf;
- **Migratory birds** which use the estuary;
- **Swimming** at Stuarts Point;
- **Non-indigenous heritage**: associated with Macleay Arm and old river pilot station & signalling;
- **Indigenous heritage**: associated with Clybucca midden.
- **Boating use**: having boating access to the river; and the range of boating opportunities on the river ranging from the common open runabouts (tinnys) to canoeing and dragon boat racing;
- **Passive recreation**: walking and picnicking;
- **Yarrahapinni wetlands**: improvements in the wetland were recognised. The role of the floodgate structure in deterring boating within the wetland was considered a positive outcome.

#### *2.1.1.2 Community Issues Raised at Initial Public Meeting*

Issues raised at the meetings have been grouped in regard to the main estuary issues addressed in the EMS:

**Table 2.1 Community Issues Raised at Initial Public Meeting**

| *Issue* | *Comments* |
|---|---|
| Riparian Land and Bank Erosion | Concerns were expressed about existing rock armour on riverbanks impacting on erosion elsewhere and cattle access causing bank erosion. There was also concern that bank erosion work by rural landowners is not recognised in the community. The recovery of habitat / in-stream vegetation after flooding was also raised as a concern. |
| Floodgates and Drains Management | Concerns were raised that deoxygenated water from drained areas is having a big impact on estuary health; and that landowners are wearing the costs of some previous flood mitigation work. |

| *Issue* | *Comments* |
|---|---|
| Flooding<br>(it is noted that the scope of the EMS does not directly address flooding): | Different views and concerns were held over the impact of various infrastructure on flood levels including concern that the height of levee banks makes flooding worse in extreme flood events, concern over the impact of Pacific Highway upgrade on flooding, and concern the Belmore Flood Control Structure (Fabri Dam) has been raised which increases upstream flood levels. |
| Boating | Concerns included boat launching facilities (wash-out of Geenhills boat ramp, insufficient parking at boat ramps); and safety issues relating to abandoned oyster beds around Fishermans Reach. |
| Fishing | Concerns were expressed that commercial fishing bans elsewhere have increased commercial fishing in Macleay estuary which is depleting fish numbers; that there is illegal beach fishing by tourists; and there is a decline in crab numbers. Beach hauling has also been noted as an issue. |
| Sedimentation and Dredging | A large number of comments were made on this topic including issues of 'silting up' at a number of locations particularly from Stuarts Point to Fishermans Reach; and suggestions that dredging is required to facilitate boat navigation in some locations. |
| Seagrass beds | Concern was voiced that large amount of seagrass beds have not recovered after the 2001 floods. There was also concern that seagrass habitat in north Macleay Arm area was being disturbed by commercial netting across the river. |
| Water Quality | A large number of comments were made on this topic. This included concern that declining water quality was making Macleay Arm undesirable for swimming and causing fish kills. Concerns were expressed regarding stormwater pollution and litter; caravan septic system overflows; and leachate from buried material at the old Stuarts Point tip. |

#### *2.1.1.3 Community Objectives Expressed at Initial Public Meeting*

Community objectives or aspirations for the estuary have also been grouped in regard to the main estuary issues addressed above:

**Table 2.2 Community Objectives Raised at Initial Public Meeting**

| *Topic* | *Objectives* |
|---|---|
| Riparian Land and Bank Erosion | ▪ improve / increase riparian buffer between farmland and the river;<br>▪ fence riverbanks to prevent cattle access;<br>▪ protect riparian zone;<br>▪ provide more funding for land owners to undertake riverbank protection works;<br>▪ establish speed limits for larger boats to limit erosion damage to banks; |
| Floodplain Wetlands / Floodgates and Drains Management | ▪ revert wetlands back to more of a 'natural' state;<br>▪ raise the inverts of drainage channels that drain the wetlands and open the floodgates more often/wider? |

| *Topic* | *Objectives* |
|---|---|
| Boating | ▪ address speed/usage of jet skis;<br>▪ establish speed limits for larger boats to limit erosion damage to banks;<br>▪ provide mooring facilities at South West Rocks (near Mattys Flat) and for boat visits from Stuarts Point / Fishermans Reach |
| Fishing | ▪ 2 bag limit for Bass is considered desirable;<br>▪ keep cattle out of river to help Bass numbers;<br>▪ need 'holes' for fish habitat / structures to attract prawns / crustaceans;<br>▪ rotate fishing sanctuary zones in different areas of the estuary (test a no-take zone for a short period including a monitoring program);<br>▪ no netting or fishing in the seagrass area in north of Macleay Arm<br>▪ providing sanctuary zone in north of Macleay Arm |
| Sedimentation and Dredging | ▪ dredging was suggested for locations raised in the 'issues' |
| Water Quality | ▪ improve water quality / monitoring in Back Creek;<br>▪ sewerage works for saltwater development;<br>▪ enforce designated truck wash-down sites to control / treat runoff |
| Climate Change | ▪ incorporate sea level rise into planning documents |
| Tourism / Recreation | ▪ 'primitive' camping sites should be considered / planned;<br>▪ improve Back Creek for tourism and amenity;<br>▪ provide boardwalks from Stuarts Point to Fishermans Reach (with interpretive signage) and to middens & Yarrahapinni wetland;<br>▪ improve cleared access (non-boating) to river for general passive recreation: weed clearing – lantana / coral trees etc.<br>▪ actively promote of river / river activities to increase tourism; |
| Estuary Health | ▪ Biological monitors such as bird numbers were suggested as a measure of success for estuary improvements |

### 2.1.2 Community Survey

A general survey and boating survey were conducted over a two month period from 21 December 2009 to 5 February 2010. The survey period coincided with school summer holidays when visitor numbers and recreational and commercial tourism activity in the region were at a peak. This provided an opportunity to capture input from the widest possible catchment of users of the estuary and also specifically users of boating facilities and access points.

#### *2.1.2.1 Survey Results*

The results for the specific 'Boating Survey' are contained in the Marine Infrastructure Assessment report in **Appendix E**. The results of the 'General Survey' are summarised below.

A total of 162 completed forms for the 'General Survey' were received at the conclusion of the survey period (see full results in **Appendix E**). Respondents identified themselves as residents from the following locations:

- 33% from the Macleay Arm Area;

- 22% from the South West Rocks / Jerseyville area;
- 21% from the Frederickton / Kempsey / Greenhill area;
- 9% from the Kinchella / Gladstone / Smithtown area;
- 6% from elsewhere within Kempsey LGA;
- 2% from Port Macquarie / Hastings LGA;
- 2% from Nambucca LGA;
- 2% from elsewhere on the Mid-North Coast;
- 1% from elsewhere within NSW; and
- 1% from interstate / overseas.

Boating is the main activity or use of the river (122 respondents) with recreational fishing (103) and picnicking/walking (101) equal second, and swimming third (78).

Responses in regard to the importance of estuary values are shown in **Plate 2.1** and include:

- water quality is considered the most important value for the estuary (160 respondents voted either "very important" or "important). Responses regarding other values included:
- 'protecting the riverbanks from erosion' was the next highest ranked value (152 votes) followed by;
- 'native riverside vegetation' (149 votes);
- most of the listed values in the survey question generally received a tick for "very important" or "important";
- all other values except for "Riverside tourist accommodation" received at least 120 votes for either "very important" or "important";
- Other suggestions of valued features included: the 'natural' setting; the vast range of wildlife in the Macleay Arm area; and mangroves.

Current access arrangements to the river, its creeks and adjoining banks: 60% to 70% of respondents were happy with boat ramp access, and vehicle and pedestrian access. Only 53% of respondents were happy with current disabled access. There were a large number of suggestions for improved or increased walkway and cycleway access along the riverbank particularly between Stuarts Point and Fishermans Reach or Yarrahapinni, and in the vicinity of Kempsey township. There was also a suggestion for improved signage / 'entry statement' reflecting the attributes of the estuary for visitors to the area or tourists passing through the area.

Current health rating of Macleay River estuary:

- water quality is rated as "moderate" to "very good" by 83% of respondents;
- fish populations / aquatic ecosystems: 45% rated it as "very poor" to "poor"; 36% "moderate" and 19% "good" to "very good";
- riverside vegetation: 34% "very poor" to "poor" ; 37% "moderate" and 28% "good" to "very good";
- bank stability: 40% "very poor" to "poor"; 40% "moderate" and 20% "good" to "very good";
- navigation: 28% "very poor" to "poor"; 40% "moderate" and 31% "good" to "very good";
- floodplain backswamps: 44% "very poor" to "poor"; 38% "moderate" and 18% "good" to "very good"; and
- oyster harvest areas: 18% "very poor" to "poor"; 59% "moderate" and 23% "good" to "very good".

Support for creation of fishing sanctuary zones in some critical locations?

- 38% indicated "strong support";
- 21% "moderate support";
- 35% "no support";

- 9% “don’t know”; and
- there were comments indicating concern that this question may lead to the creation of sanctuary zones without any further consultation beyond the survey.

Issues of concern:

- “poor water quality and fish kills after flooding” received the highest number of ‘votes’ (145) for either “very concerned” or “concerned”;
- the order of the issues of concern based on the number of votes for either “very concerned” or “concerned” were:
  - spread of aquatic weeds (141);
  - inadequate treatment of stormwater and effluent (138);
  - commercial / industrial development along the river edge (136);
  - acid sulfate soils (131);
  - bank erosion (131);
  - degraded floodplain backswamps / wetlands (130);
  - overfishing (127);
  - operation of floodgates and drainage works (127);
  - protection of the shellfish industry (124);
  - lack of habitat protection (123);
  - lack of riverside vegetation (123);
  - urban / residential development along the river edge (119);
  - scenic amenity (117);
  - dredging of the river (112);
  - cultural heritage (indigenous) (84);
  - sea level rise and climate change (69); and
  - other (please describe) (26): the impact of commercial fishing / netting on fish stock and the impact of floodgates on fish passage / ecological processes both received a significant number of votes as an additional issue (approximately 10 to 20 votes); fertilizer / pesticide / herbicide runoff from farmland was also suggested by a number of respondents as an additional issue.

### 2.1.3 Stakeholder Consultation

The organisations listed below were consulted to obtain initial input to the study. Input received from various organisations has been incorporated into the assessment of the relevant issues in the EMS. Letters that were received from organisations have been included in **Appendix E**.

- Kempsey Shire Council
- NSW Department of Environmental and Climate Change and Water (DECCW)
- NSW Fisheries (now Primary Industries - Industry & Investment NSW)
- Coast and Estuary Management Committee
- Northern Rivers Catchment Management Authority
- NSW Department of Water and Energy (now DECCW – NSW Office of Water)
- DECCW – Parks and Wildlife
- Macleay Valley Coast Tourism
- Macleay Landcare Network
- Kempsey Local Aboriginal Land Council
- Booroongen Djugun Aboriginal Corp
- Macleay Landcare Network
- Chamber of Commerce – Kempsey & District
- Chamber of Commerce & Industry

Incorporated – South West Rocks

- DECCW – Coastal Waters Unit
- Land and Property Management Authority
- NSW Maritime
- Macleay River District Fishermans Cooperative
- Bass Kempsey
- NSW Food Authority

### 2.1.4 Discussion of Results

*2.1.4.1 Community Values*

The estuary values derived from the public meetings and survey results may generally be classified as:

- values associated with recreational use of the estuary; and
- physical estuary features valued by the community.

In respect to values associated with recreational use, the main values are boating; recreational fishing; passive recreation (picnicking / walking); and swimming.

The main physical attributes of the estuary that are valued by the community are water quality, riverbank protection (from erosion), riparian vegetation and floodplain wetlands. A ranking of values from the survey results based on the number of "very important / important" responses is shown in **Plate 2.1**.

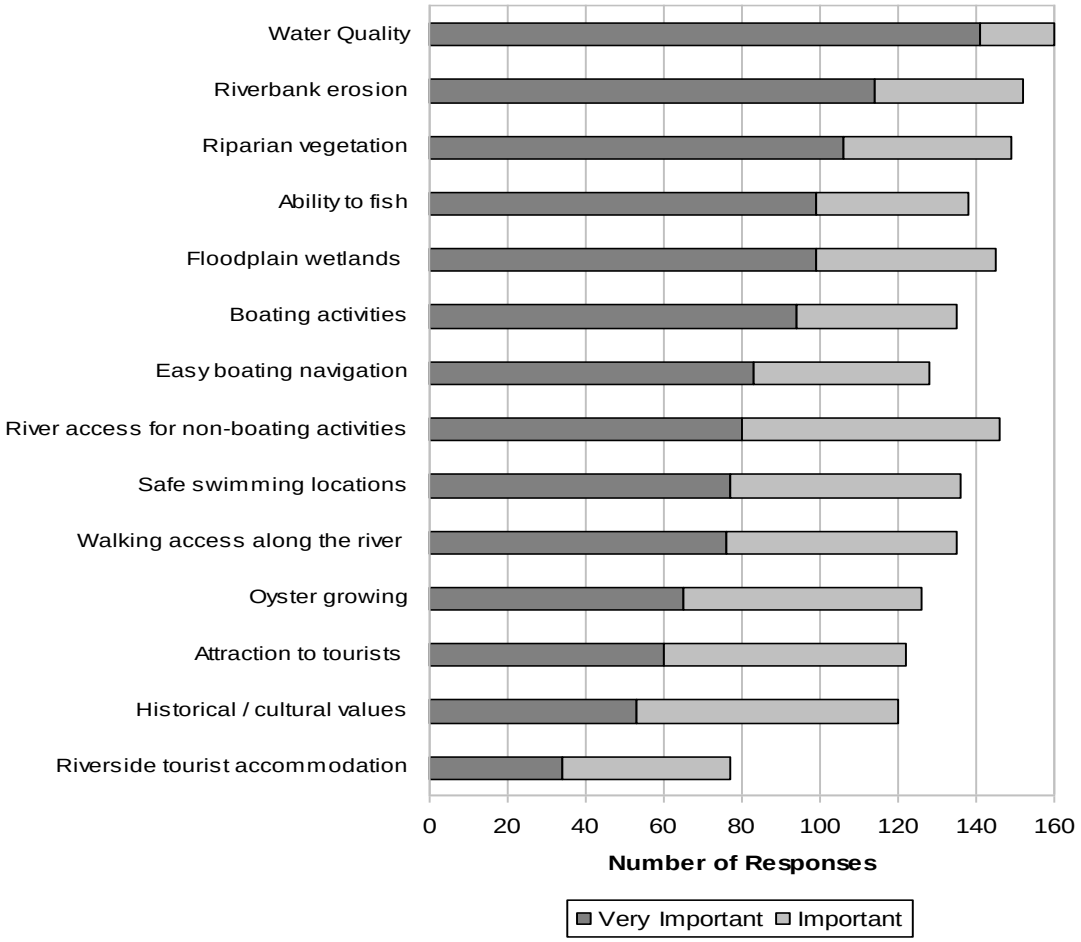



**Plate 2.1 Ranking of Values from Community Survey**

### *2.1.4.2 Issues*

The public meetings indicate that the main community issues concern water quality and the impact of sedimentation on boating navigation. This is based on the larger number of comments provided at the meetings in respect to these two issues compared with other issues. The community survey results support the finding that water quality is one of the major concerns for the estuary. The issue of sedimentation impacting on boating navigation was not highlighted in the survey results however this may be a result of the wording of the survey which asked if dredging was an issue. A ranking of concerns from the survey results based on the number of "very concerned / concerned" responses is shown in **Plate 2.2**.

Other community issues arising from the survey results generally reflect the issues of concern and their relative importance raised by the Coast and Estuary Management Committee and the Catchment Management Committee. The committee issues and priorities are outlined in **Section 2.3**.

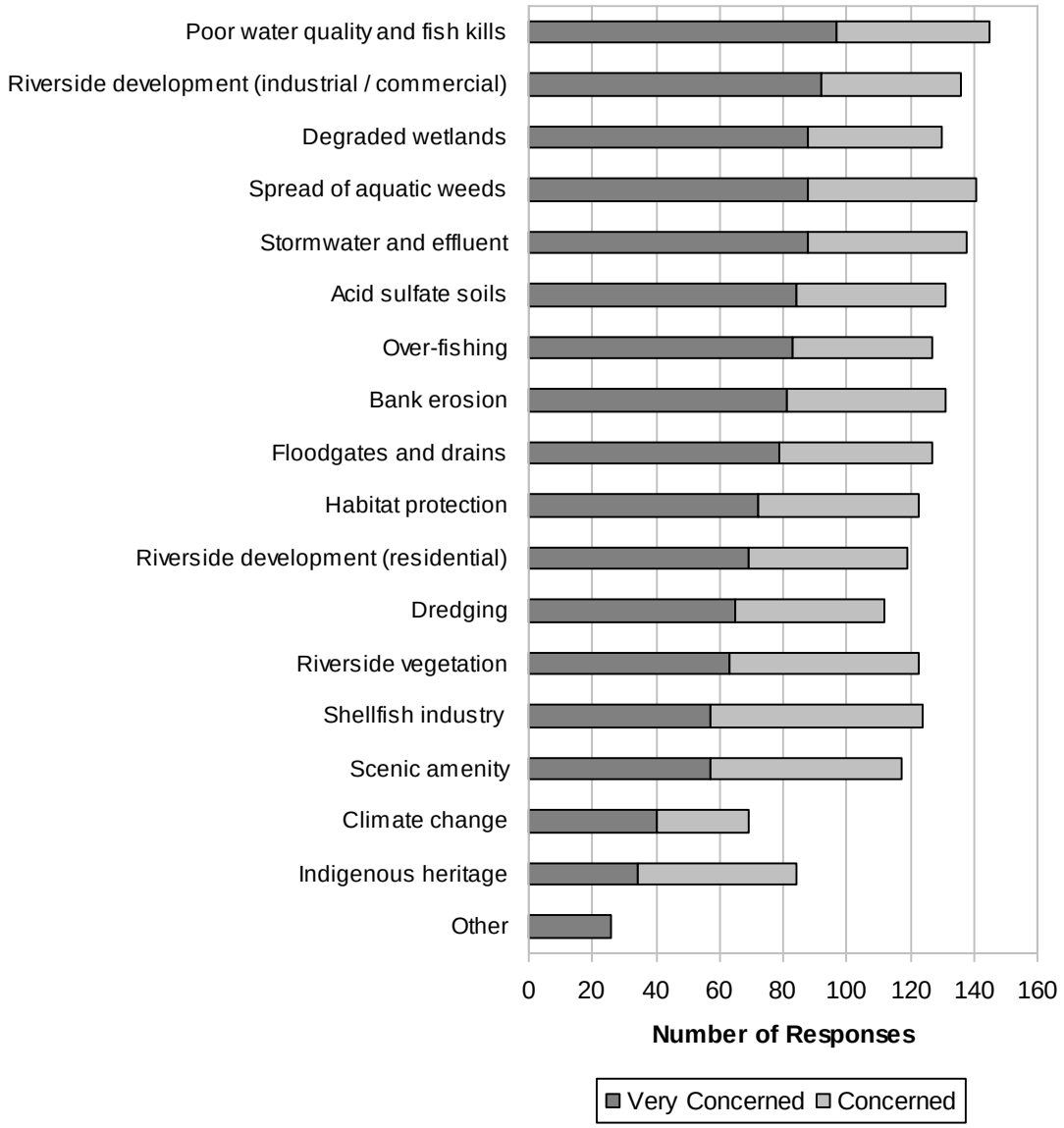



**Plate 2.2 Ranking of Concerns from Community Survey**

#### *2.1.4.3 Objectives*

Community objectives for the estuary generally relate to maintaining or improving the recreational values and physical attributes valued by the community. The main objectives are summarised as:

- **Riparian Management and Bank Erosion**: expand riparian areas and protect the banks from impacts such as cattle access and erosion;
- **Floodplain Wetlands / Floodgates and Drains Management**: revert wetlands back to more a 'natural' state and minimise the impact of floodgates and drains on water quality;
- **Boating**: improve boat launching facilities and managed boating areas to avoid conflict between different boating activities;
- **Fishing**: protect fish stocks by investigating impacts of commercial fishing and implementing measures such as sanctuary zones;
- **Sedimentation and Dredging**: investigate dredging to improve boating navigation;
- **Water Quality**: improve water quality in Back Creek and Macleay Arm and minimise fish kills from drainage systems;
- **Tourism / Recreation**: improve access to the river for non-boating activities; support river-based tourism; improve amenity of Back Creek in regard to water quality and boating navigation; and investigate walking paths / boardwalks in Macleay Arm area; and
- **Climate Change**: incorporate sea level rise into planning.

## 2.2 Ecological Values

Aside from the inherent ecological values of a large estuarine system the ecological values of the Macleay River estuary include:

- A large and diverse fauna. This is the basis of a large recreational fishing industry and the Macleay River Estuary general fishery. Under sustainable harvest conditions the Macleay River fisheries provide a degree of local food security;
- A large, healthy population of East Australian Bass, an iconic sportfish;
- Threatened aquatic species including the estuary cod (*Epinephelus coioides*), and black cod (*Epinephelus daemelii*) are known to inhabit waters of the Macleay. In the case of the estuary cod, anecdotal evidence suggests that the population is a large and healthy one;
- Regular visits by aquatic mammals are known to occur. During the preparation of this study, bottle nose dolphins (*Tursiops aduncus*) were sighted on the Macleay River as far upstream as the Jerseyville Bridge;
- A large and diverse avifauna. Wetland areas on the Macleay are host to a wide variety of migratory and resident birds, including at least 9 species listed under the NSW *Threatened Species Conservation Act 1995* and 47 migratory species listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*. Important species include the black necked stork, brolga, osprey, black tailed godwit and common greenshank;
- Extensive mangrove, saltmarsh and seagrass ecosystems. These systems account for a significant proportion of the overall productivity of the river in addition to providing habitat for fish and invertebrates. These systems are important since many marine species rely on or utilize estuarine ecosystems to complete parts of their lifecycle. Salt Marsh habitat on the North Coast is listed as an Endangered Ecological Community. Mangrove, saltmarsh and seagrass habitat are listed and protected as Marine Vegetation under the Fisheries Management Act 1994; and
- numerous significant wetlands, including 66 protected under SEPP 14 legislation and 2 listed under the Directory of Important Wetlands of Australia (DIWA).

## 2.3 Summary of Estuary Values and Issues

The estuary management study is largely directed by the values, issues and objectives derived from the community and stakeholders. To assist understanding the range of issues and objectives for the estuary, a summary is provided in **Table 2.3**.

**Table 2.3 Summary of Community and Stakeholder Estuary Values and Issues**

| *Topic* | *Value* | *Issues* | *Objectives* | *Importance / Priority* |
|---|---|---|---|---|
| Riparian Management and Bank Erosion | ▪ Riparian vegetation is significantly valued by community<br>▪ Riparian vegetation: ecological benefits for habitat / corridors; scenic qualities; assists erosion control | ▪ Lack of native riparian vegetation corridor<br>▪ riverbank erosion<br>▪ overuse of rock armouring for embankment protection; | ▪ increased riparian areas and protection from impacts such as cattle access and erosion<br>▪ address bank erosion areas | High |
| Floodplain Wetlands Management | ▪ significantly valued by community<br>▪ wetlands form a large component of the estuary and provide important functions in regard to estuary health | ▪ most of the wetlands are degraded which impacts on water quality, habitat, and fisheries | ▪ understanding key functions of floodplain wetlands and relative importance of specific wetland areas<br>▪ rehabilitate degraded wetlands | High |
| Acid Sulfate Soils | - | ▪ the floodplain is underlain by high risk ASS<br>▪ impacts on water quality, soils, agricultural productivity | ▪ minimise exposure of ASS<br>▪ remediate acid scald areas | High |
| Floodgates and Drain Management | ▪ important for flood mitigation, wetland management and pasture management | ▪ over-drainage of backswamps increases exposure of ASS and causes acid scalding, poor water quality, reduced agricultural productivity, and degraded wetland habitat<br>▪ Drainage of backswamp areas has enabled changes in pasture species resulting in water quality issues during extended flood events | ▪ actively manage floodgates to achieve best outcomes in terms of flood mitigation and water quality / ASS management / wetland management; and<br>▪ clear management regime in both flood and non-flood events. | High |

| *Topic* | *Value* | *Issues* | *Objectives* | *Importance / Priority* |
|---|---|---|---|---|
| Boating | ▪ boating activities highly valued by community | ▪ Siltation and weed growth along foreshores preventing water access and navigation at key locations of the river;<br>▪ lack of adequate, safe launching facilities, particularly for short term mooring;<br>▪ need for improved amenities to enhance riverside locations for family day use;<br>▪ conflict between incompatible uses and their proximity to nearby residential areas; | ▪ improve boat launching facilities and manage boating use areas to avoid conflict between different boating activities | High |
| Sedimentation and Dredging | ▪ satisfactory navigation of waterways | ▪ Impact on boating navigation is a significant issue to community | ▪ determine if dredging is a potential management option for improving navigability in specific locations | High<br>(based on community feedback from the survey regarding boating navigation) |
| Tourism | ▪ river-based tourism is a significant tourism industry for the region | ▪ increased demand on boating facilities | ▪ improve access to the river for non-boating activities; support river-based tourism; improve amenity of Back Creek in regard to water quality and boating navigation; and investigate walking paths / boardwalks in Macleay Arm area | Medium |

| *Topic* | *Value* | *Issues* | *Objectives* | *Importance / Priority* |
|---|---|---|---|---|
| Habitat Protection / Threatened Species | ▪ floodplain contains a significant proportion of the states mangroves and wetlands<br>▪ floodplain provides an opportunity to support regional habitat corridor | ▪ habitat areas are fragmented within the floodplain<br>▪ a very small proportion of the estuary has environmental protection under Councils LEP / Parks management | ▪ Protect and manage critical habitats | High |
| Fishery Management | ▪ Recreational fishing highly valued by community | ▪ Threats to fisheries from poor water quality associated with floodplain drainage systems<br>▪ Loss of key habitat associated with wetlands | ▪ Community objective to protect fish stocks<br>▪ Address causes of poor water quality relating to drainage systems<br>▪ Improve fish productivity and key habitat areas | High |
| Water Quality | ▪ highly valued by community | ▪ poor water quality is a significant issue to community<br>▪ impacts associated with floodplain drainage systems<br>▪ water quality impacts on fisheries | ▪ Community objective to improve water quality in Back Creek and Macleay Arm and minimise fish kills from drainage systems that result in fish kills<br>▪ Address causes of poor water quality associated with drainage systems | High |
| Climate Change | ▪ moderately valued by community | ▪ Sea level rise impacts on estuary ecology, floodplain wetlands, drainage systems, floodplain agriculture, and infrastructure | ▪ incorporate sea level rise into estuary planning framework | High Importance<br>Medium Priority |
| Heritage Issues | ▪ moderately valued by community | ▪ No significant issues | ▪ Heritage issues to be considered in the development of other management strategies | Low |

| *Topic* | *Value* | *Issues* | *Objectives* | *Importance / Priority* |
|---|---|---|---|---|
| Estuary Health | ▪ highly valued | ▪ Lack of understanding of ecological health of Macleay estuary<br>▪ Lack of understanding of interactions of estuary components | ▪ improve understanding<br>▪ develop monitoring system to measure ecological health | High |

## 2.4 Estuary Uses

### 2.4.1 Land Use Zoning

The entire Macleay estuary and 25% of the Macleay Catchment fall inside the Kempsey Shire Local Government Area (LGA). The Upper Macleay Catchment falls with four LGAs - Walcha, Armidale Dumaresq, Uralla and Guyra (WMAwater, 2009).

Landuse zonings in the estuary are shown in **Illustration 2.1**. Eight major land use zoning categories exist for the Macleay estuary with:

- almost 90% of the total Macleay catchment zoned Rural of which approximately 60% is zoned Rural 1 (a1). Forestry 1(f) and Agricultural Protection 1(a3) occupy the other rural zonings;
- National Parks and Reserves 8(a) covers approximately 7% of the catchment;
- Protection (7) covers approximately 4% of the catchment; and
- Urban areas (including residential, business, industrial zonings and special use areas) occupy less than 1% of the catchment (WMAwater, 2009).

Kempsey Shire Council is currently preparing a new LEP consistent with the Standard Instrument – Principal Local Environmental Plan (SLEP). According to the SLEP, there are three waterway zones that may be applicable to waterways:

| | |
|---|---|
| Zone W1 | Natural Waterways |
| Zone W2 | Recreational Waterways |
| Zone W3 | Working Waterways |

Applying the most appropriate zoning will need to consider the tenure, anticipated usage and any land use protective or management measures.

### 2.4.2 Land Use

**Historical Land Use**

Historically, the Macleay area was inhabited by Aboriginal peoples. European land use began with settlement in the 1830s. Timber cutting and ship building were the main land uses up until the early 1900s (WMAwater, 2009).

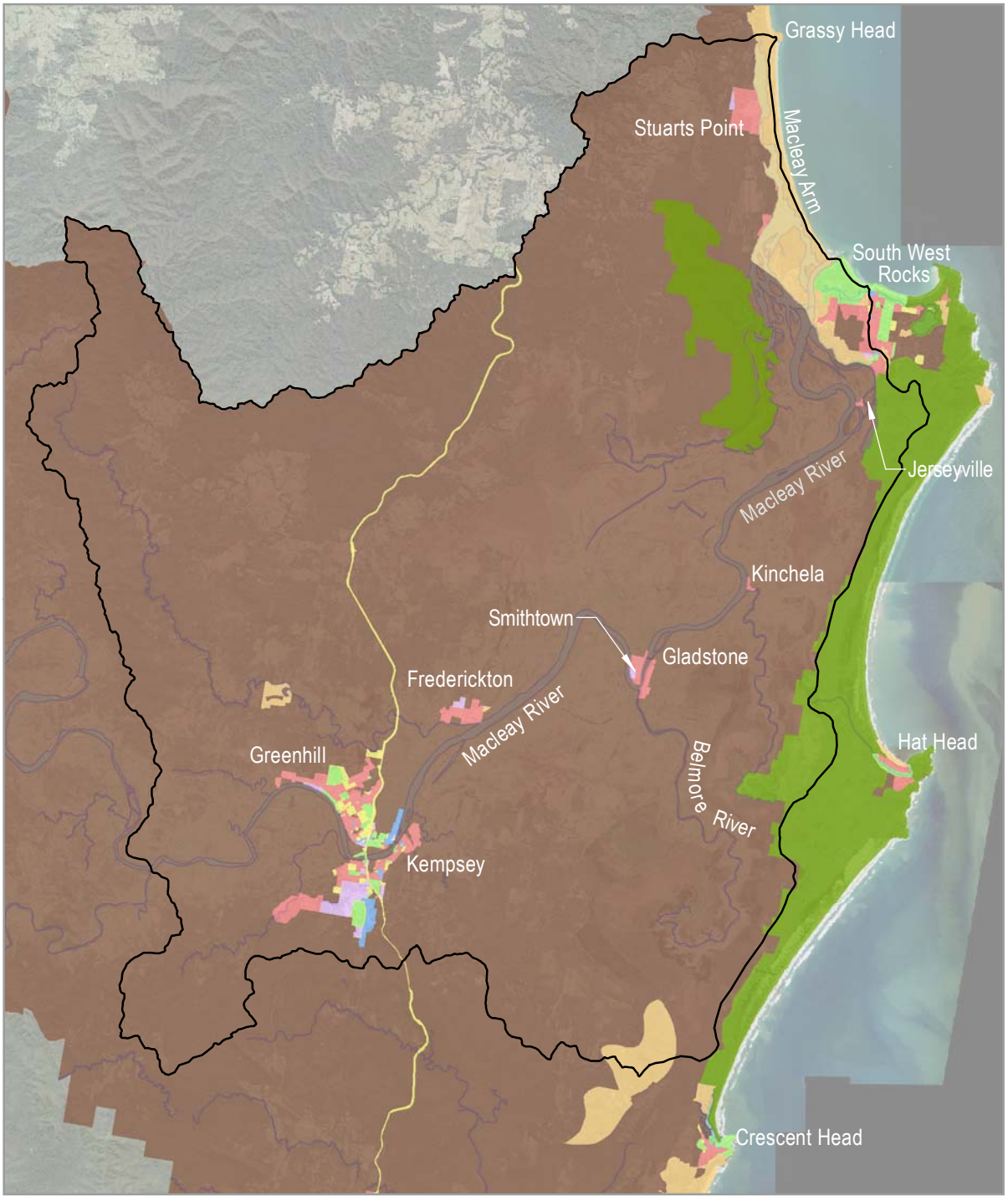
Early settlements were formed in lower Macleay, including the establishment of Kempsey in 1835. Between 1863 and 1875 there were 18 floods of which eight were considered serious. However, the advantages of settling on the floodplains for many years outweighed the disadvantages (Telfer, 2005).

The Upper Tablelands were settled and cleared for agriculture, including beef, and sheep grazing. Cropping also occurred to the west. Escarpment, gorge and upper hill countries were not suited to cultivation, but some areas were logged (WMAwater, 2009).

Small areas of mining of metals and antimony occurred along the catchment, with a few major mines. These mines were situated at Hillgrove, Rockvale, Enmore-Rose, Halls Peak (near Jeogla) and Mungay Creek (near Willawarrin). Much contamination (including effluent runoff, acid mine drainage, arsenic, and antimony) has occurred in the Macleay catchment due to waste materials disposal and leakage from the mining systems (WMAwater, 2009).

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*




LEGEND

- Study area
- Rural (1)
- Residential (2)
- Business (3)
- Industrial (4)
- Special Uses (5)
- Open Space (6)
- Protection (7)
- National Parks (8)

0 5 km

North

# Landuse Zonings

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1352711

Illustration 2.1

**Current Land Use**

Land uses in the Macleay catchment are diverse, and include cattle and sheep grazing on tablelands, dairying, horticulture and cropping, light industry, mining and quarrying, forestry, residential development, tourist development, fishing and oyster farming (WMAwater, 2009).

Upper tablelands of the Macleay are cleared for grazing and cropping. The escarpment, gorge and upper hill countries are mainly vegetated, with National Park, Crown Land or State Forest the main uses, with some minimal logging continuing. The floodplain and estuary of the Macleay is mainly cleared for agriculture, including grazing pasture and crop production. Mining land uses have decreased recently, with only the Hillgrove mine still operational (WMAwater, 2009).

Settlements along the Macleay catchment include the major towns of Armidale, Kempsey, Walcha, Guyra and South West Rocks, which comprise residential, commercial and light industrial land uses (WMAwater, 2009).

General land use characteristics of the estuary study area include:

- intensive horticulture around Fishermans Reach;
- unsewered townships of Stuarts Point and Fishermans Reach adjoining Macleay Arm;
- National Park adjoining the eastern boundary of the estuary (Hat Head National Park) and to the west of Fishermans Reach (Yarrahapinni Wetlands National Park); and
- Agriculture consisting primarily cattle grazing through the middle floodplain portion of the study area. This landuse occurs largely on drained and flood and acid prone lands.

### 2.2.3 Waterway Use

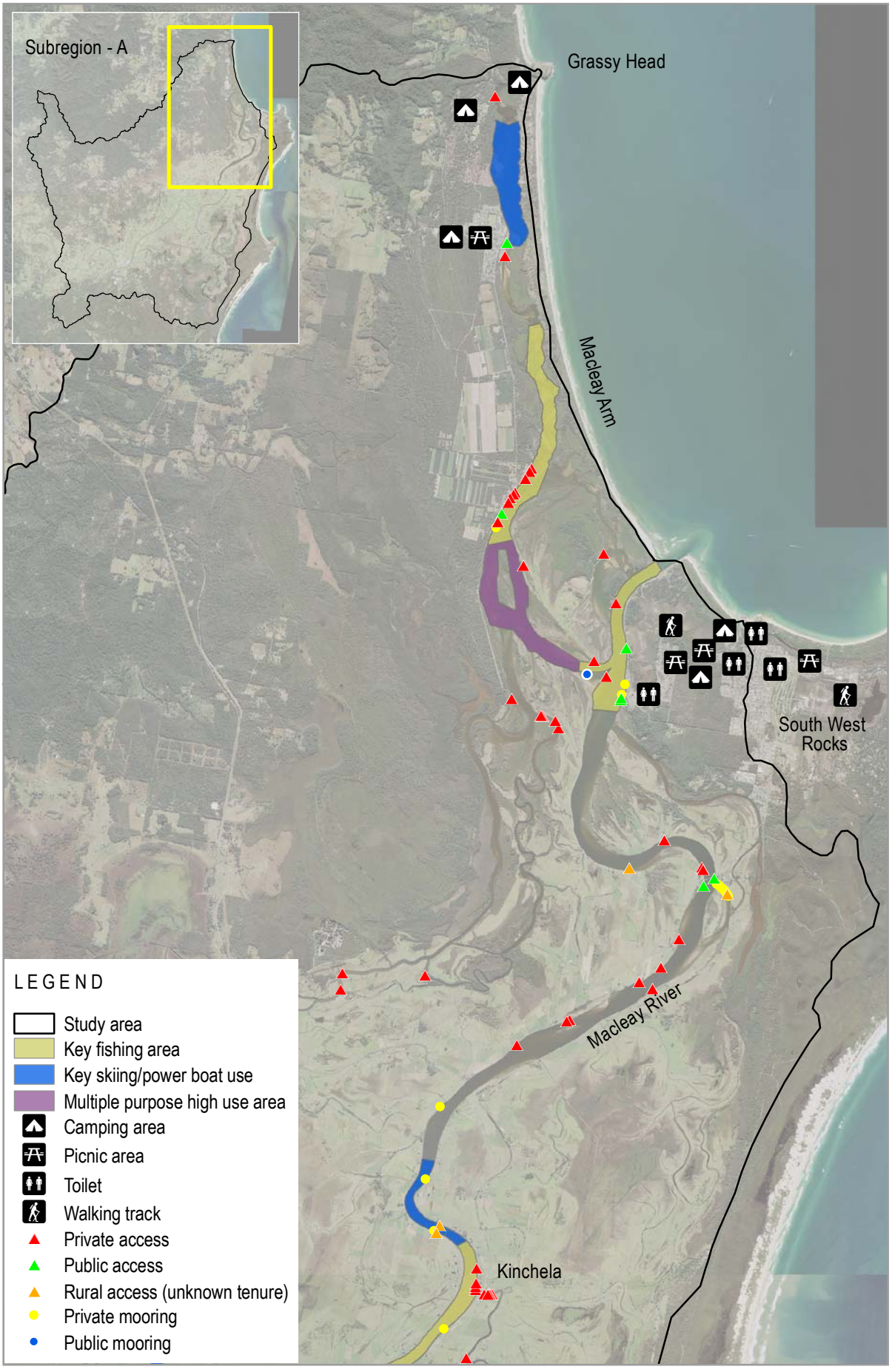
Waterways in the Macleay estuary support significant boating and fishing activities. **Illustrations 2.2** to **2.4** show the locations of current waterway access and usage.

The fisheries resources of the Macleay include the estuary general fishery and shellfish aquaculture. Estuary prawn trawling is no longer a significant industry on the Macleay. Oyster farming is the most valuable fishery managed by NSW Industry and Investment. The Macleay contributes in an average year approximately $500,000 worth of production which represents approximately 2% of the total production for NSW.

Recreational fishing is estimated to be worth in excess of $40 million to the mid north coast regional economy (Telfer 2005). Over 74000 recreational fishers, representing almost 30% of the population, operated on the mid-north coast of NSW during the survey period (NSW Fisheries 2001). The Macleay estuary is likely to represent a significant proportion of the above numbers. The majority of the recreational catch was taken in estuarine waters and the Macleay is the second largest river system in the mid north coast region.

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*




North

0 2 km

# Estuary Access and Usage - Subregion A

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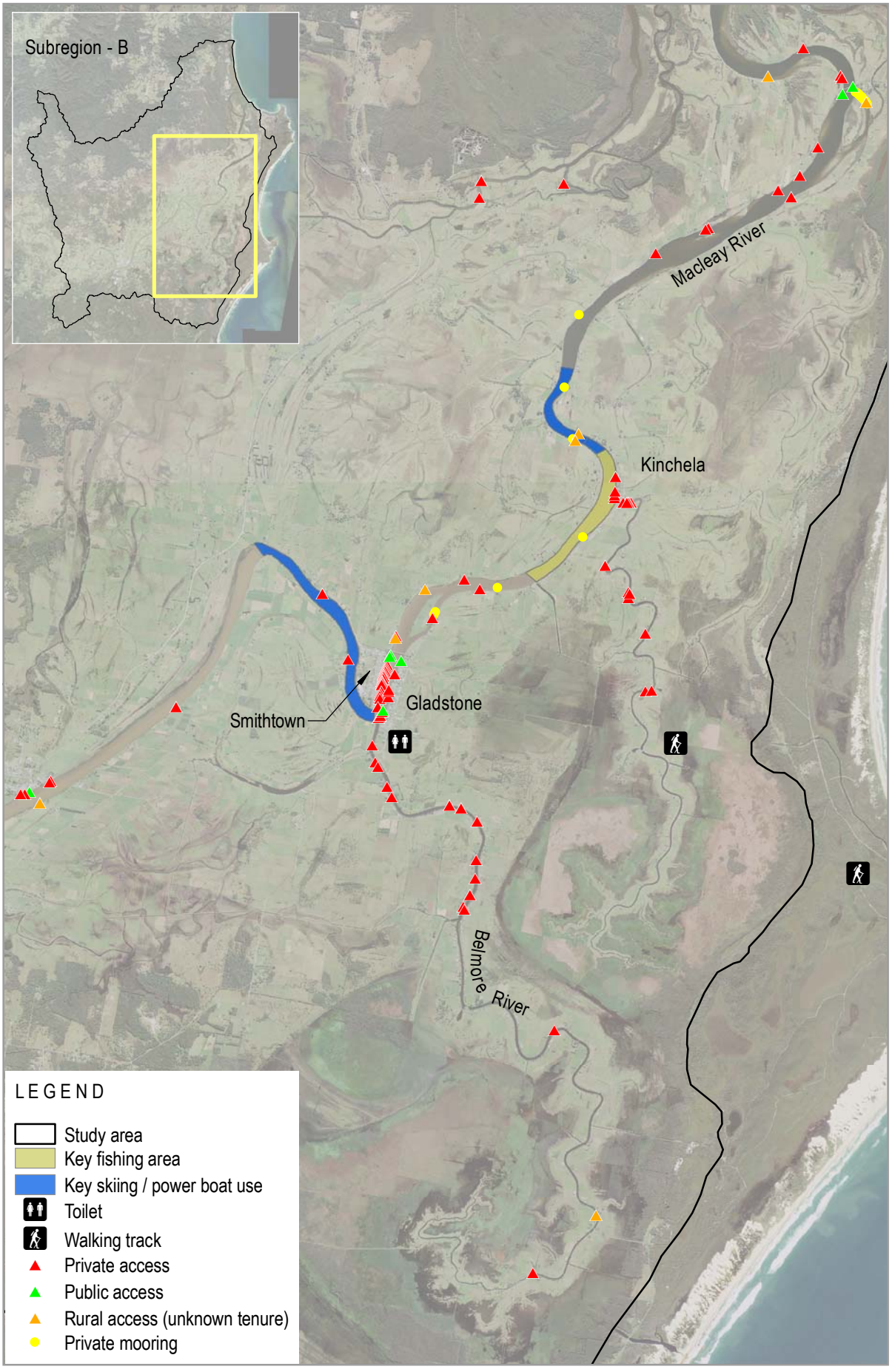
1352751

Illustration 2.2

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*




North

0 2 km

# Estuary Access and Usage - Subregion B

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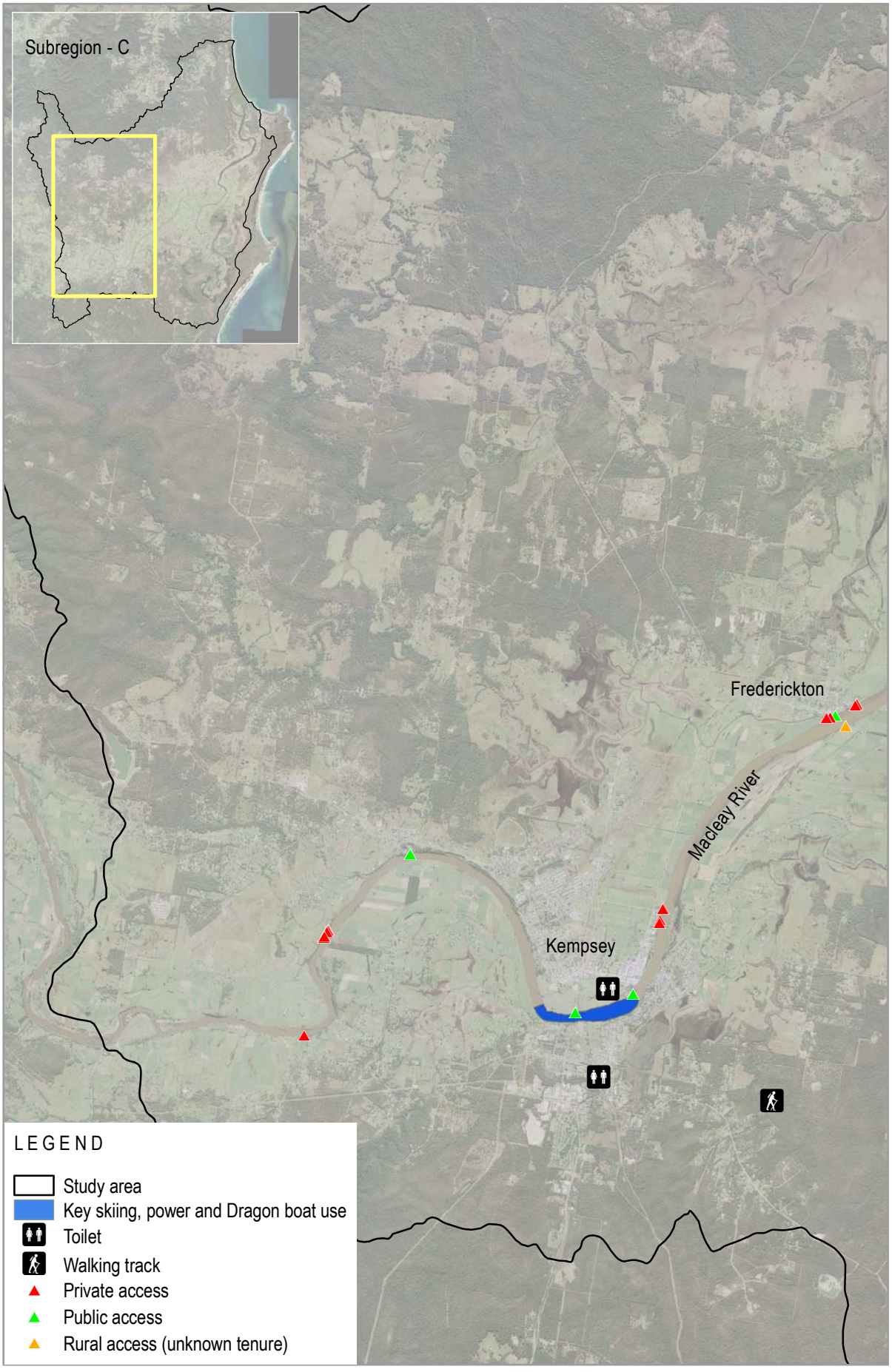
Macleay River Estuary Management Study
1352752

Illustration 2.3

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*

*Information shown is for illustrative purposes only*




North

0 2 km

# Estuary Access and Usage - Subregion C

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352753

Illustration 2.4

# 3 Riparian Management and Erosion

Riparian management and bank erosion have been identified by the EMC as a major issue for the Estuary Management Planning Process. Some of the outcomes desired by the EMC include;

- reducing bank erosion and retaining the river in its current location;
- increasing stability of all riparian lands;
- protecting existing areas of native riparian vegetation and rehabilitation of other areas;
- creating vegetated corridors throughout the estuary; and
- improving treatment of riverside public lands within villages and towns.

The following discussion outlines the current status of bank erosion and riparian management issues in the estuary, outlines a set of guiding principles and objectives for riparian and bank management, and recommends management strategies that will be further considered in the development of the Macleay River Estuary Management Plan.

## 3.1 Current Status

### 3.1.1 Bank Erosion

A survey by Cohen (2005) indicates approximately 10% of Macleay River and its tributaries experience minor to severe erosion and the remaining 90% are stable. Approximately one quarter of the stable banks are stabilised with rock revetment or other material, the remainder are considered naturally stable. The fluvial process zone (from Belgrave Falls to Kinchela) has the most severe bank erosion in the estuary (**Table 3.1**).

The erosion statistics presented do not include erosion resulting from the 2009 floods. A resurvey of the estuary study area is beyond the scope and resources of the EMS. However, the pre-2009 survey results are considered satisfactory for the purpose of developing appropriate management strategies and priorities.

The results of the erosion mapping from 2005 are shown in **Illustration 3.1** to **3.3**.

**Table 3.1 Bank Erosion Statistics**

| | *Total Length (km)* | *Survey length (km)* | *Stable (km)* | *Minor Erosion (km)* | *Moderate Erosion (km)* | *Severe Erosion (km)* | *% Naturally Stable* | *% Rock Stabil'd* | *% Minor* | *% Moderate* | *% Severe* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Entire Estuary** | 357 | 270 | 245 | 18 | 4 | 3 | 65 | 25 | 7 | 2 | 1 |
| **Process Zones:** | | | | | | | | | | | |
| Fluvial | 187 | 134 | 120 | 8.0 | 2.8 | 3.0 | 70 | 20 | 6 | 2 | 2 |
| Transitional | 81 | 69 | 61 | 6.3 | 1.2 | - | 51 | 38 | 9 | 2 | - |
| Marine | 96 | 70 | 66 | 3.8 | - | - | 72 | 22 | 6 | - | - |

*Information shown is for illustrative purposes only*

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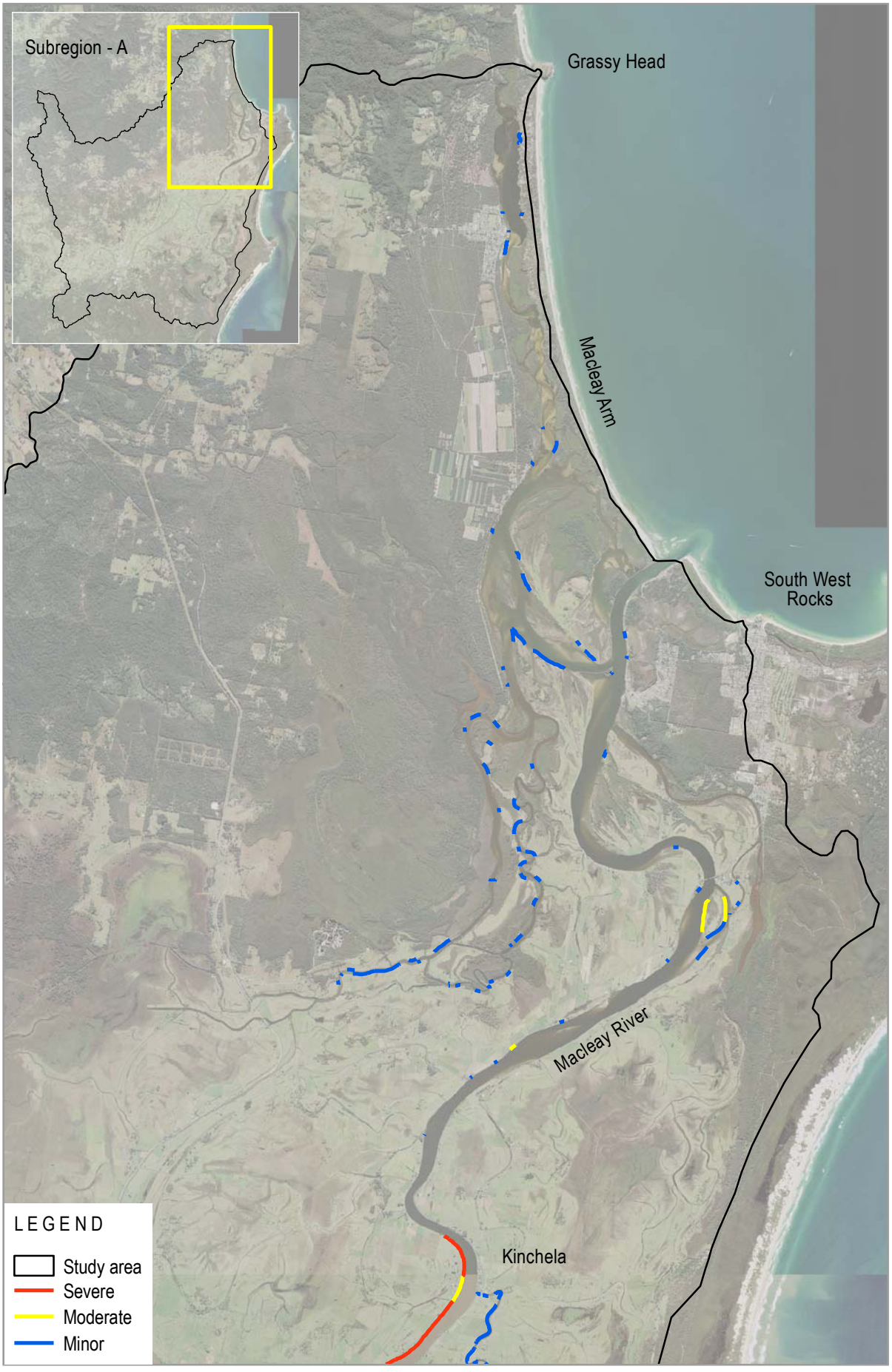
*Source of base data: Kempsey Shire Council*




North

0 2 km

# Existing Bank Erosion - Subregion A

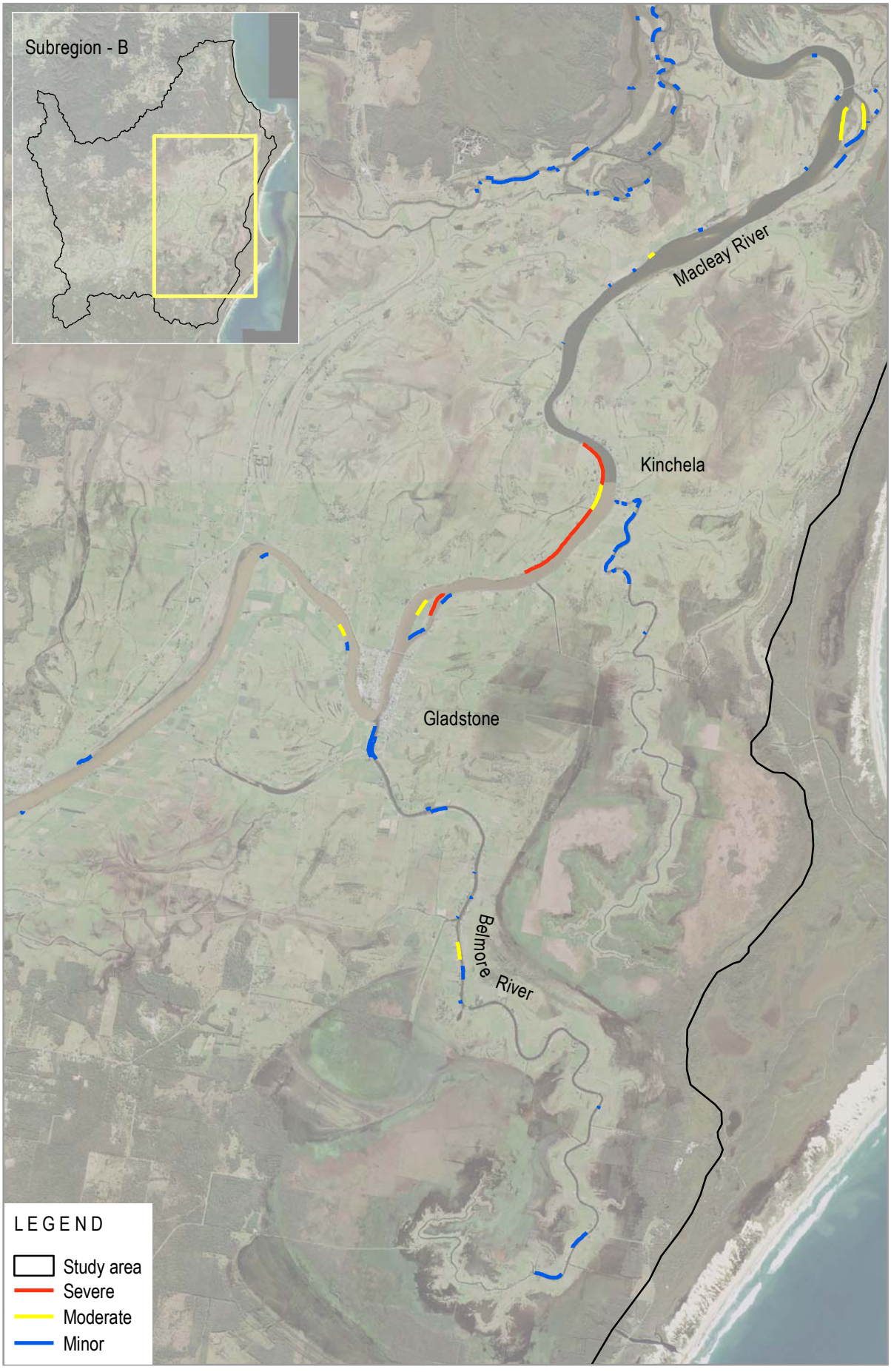
GeoLINK environmental management and design

Macleay River Estuary Management Study
1352704

Illustration 3.1

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: May 2010*
*Source of base data: Kempsey Shire Council*




0 2 km

North

# Existing Bank Erosion - Subregion B

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352705

Illustration 3.2

*Information shown is for illustrative purposes only*

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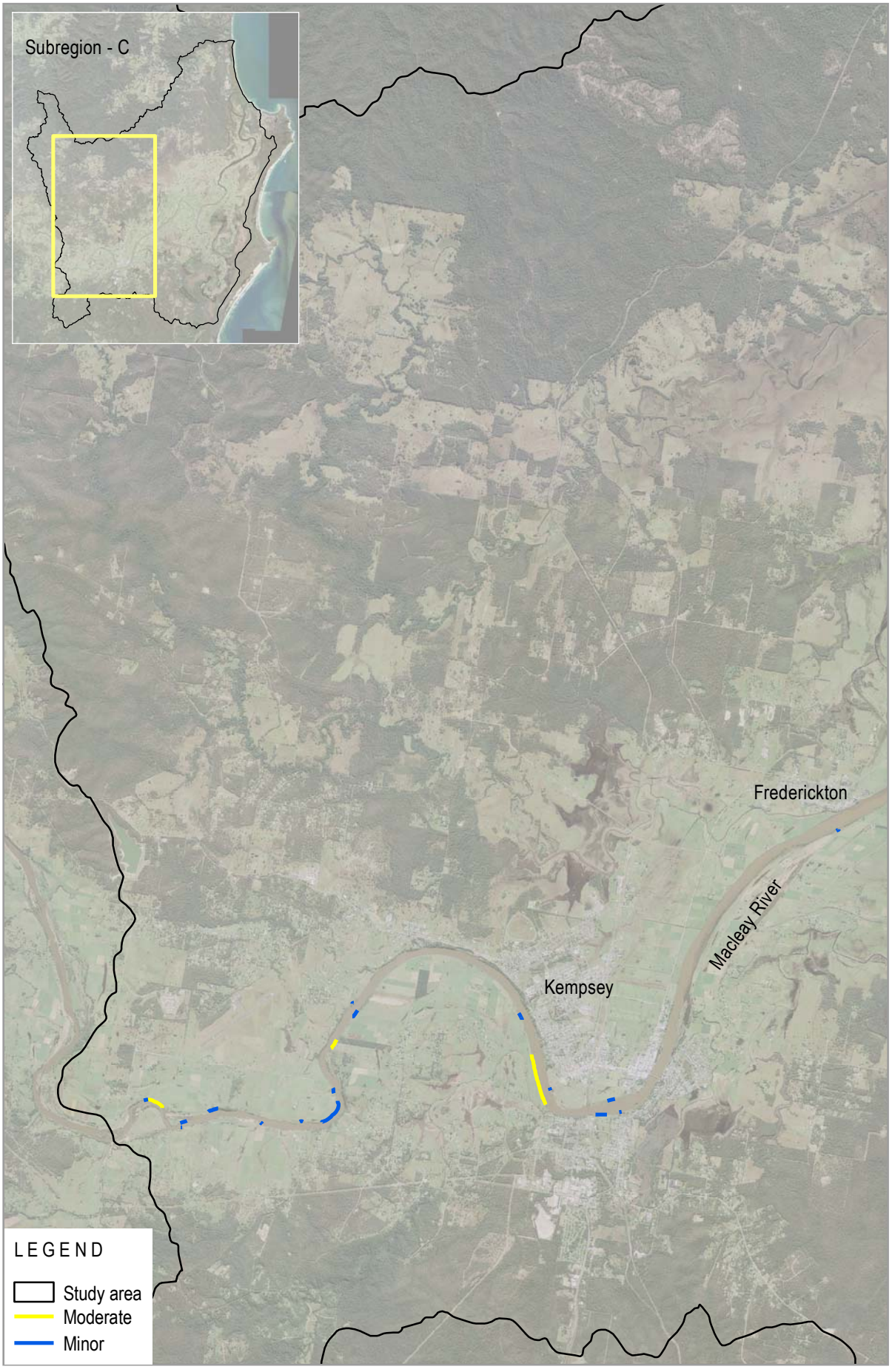
*Source of base data: Kempsey Shire Council*




0 2 km

North

# Existing Bank Erosion - Subregion C

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352706

Illustration 3.3

The major causes of bank erosion are dependent upon a number of factors including underlying morphology of the banks and floodplains, dominant processes, native vegetation cover, extent of existing bank protection measures, and adjacent land and waterway usage. According to Cohen (2005), the dominant causes of bank erosion in the Macleay estuary are:

- Fluvial processes (i.e. driven by freshes and floods);
- Wind and/or boat waves;
- In-channel sedimentation;
- Stock disturbance/reduced riparian vegetation; and
- Presence of rockwork on adjacent banks.

The relative role of these controls varies considerably between process zones and is partly determined by local factors including whether the bank has a deep or shallow water profiles, the local land and waterway usage, the estuary planform, sediment distribution, and relative dominance of fluvial/tidal/marine processes. Furthermore, the history of catchment disturbance in the Macleay valley, including the 1.24 million tonnes of sediment that have been dredged from the estuary between 1929 and 1963, continues to have important impacts on estuarine processes (Telfer, 2005).

In terms of types of erosion occurring in the estuary, there are generally two main drivers of erosion processes, 'episodic processes' being the primary driver of erosion in upper more fluvial dominated reaches, and 'continuous processes' which are more prevalent in middle to lower reaches of the estuary.

Types of episodic or event-based processes include:

- Slab type block failure resulting from inundation and subsequent slumping, with material generally not remaining in situ;
- Rotational failures and slumps related to either subsoil drainage or draw-down effects as water level drops with rapidly receding flood levels, with material generally remaining in situ; and
- Scour resulting from high velocity flows often acting on the bank toe. Material does not remain in situ. Scour associated with major flooding can remove the evidence of slab type block failures.

**Plate 3.1 Rotational Slump Failure**

**Plate 3.2 Bank Notching by Wind / Boat Waves**

Types of continuous processes include:

- Slab type block failure resulting from undercutting of the bank toe as a result of wave or wind action or scour, with material often remaining in situ;
- Notching of the bank toe or fretting as a result of wave action (wind or boat) and subsequent undercutting and failure; and
- Disturbance of banks through unmanaged stock access, inappropriate land use, or the removal and/or suppression of riparian vegetation.

**Plate 3.3 Stock Impacts on Banks**

Source: Cohen, 2005

Although separating the types of processes facilitates explaining how erosion occurs in estuaries, in reality the processes are interrelated. For example, continuous effects such as unmanaged stock access can lead to suppression of the mangrove and river reed fringe which as a result of continuous wave wash from wind and boats can cause the banks to become undermined and susceptible to episodic damage from flood events.

As a consequence it is important to accurately determine the causes and types of erosion occurring at sites where remedial action is planned if a long-term and cost-effective solution is to be achieved.

### 3.1.2 Riparian Vegetation

Riparian habitats are a significant component of estuarine and floodplain environments. Riparian habitat values include fisheries habitat, terrestrial habitat, bank stability and maintenance of soil structural integrity, landuse "buffers", water quality and filtering values and aesthetic values (WBM 2006).

The vegetation of the Macleay estuary has been described in numerous studies over the past three decades including:

- East Kempsey Vegetation Mapping project (Telfer and Kendall, 2006);
- Wetland mapping undertaken by Wetland Care Australia (2006); and
- Riparian vegetation mapping by ID Landscape Management Pty Ltd as part of the Macleay Estuary Data Compilation study (Geco Environmental 2005).

Most relevant to the EMS and EMP is the 2005 assessment by ID Landscape Management of the Macleay Estuary riparian vegetation. The study assessed the type and condition of bank vegetation, the occurrence and distribution of weed species, and the presence of important vegetation species. Fourteen percent (14%; 48km of river bank) was identified as being in intact condition, in that the vegetation assessed was considered to be in essentially 'natural' condition with few signs of disturbance. Two thirds of river banks (232km) were considered to have a high degree of disturbance (identified as having a high degree of removal of vegetation structure or degradation of native cover with either extensive or minimal weed invasion depending on management practices), with a further 19% (67km) of banks mapped as having low, or low-moderate levels of disturbance. The major disturbance factors identified were (Geco Environmental, 2005):

- Clearing of the bank/riparian vegetation;
- Ongoing disturbances associated with grazing and some agricultural practices;
- Disturbance associated with infrastructure including roads in close proximity to the river, and bank protection works;
- Weed invasion including into otherwise intact remnant vegetation; and
- Disturbance associated with periodic flooding.

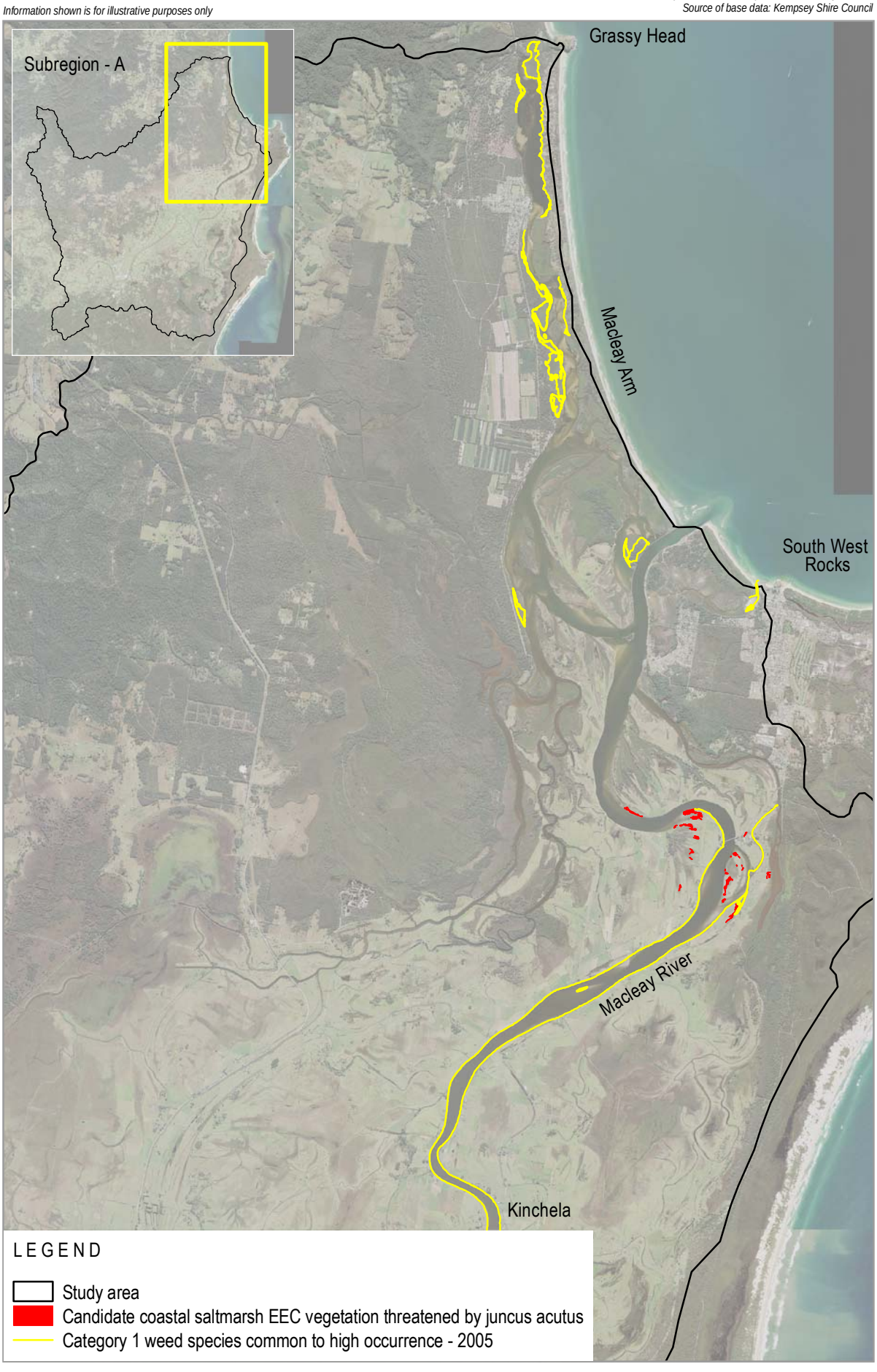
### 3.1.3 Riparian Weeds

The assessment of riparian vegetation undertaken by ID Landscape Management for the 2005 Estuary Data Compilation Study mapped the extent of weed infestation in the estuary riparian zone. The most serious environmental weeds (Category 1) include madiera vine (*Anredera cordiflora*), balloon vine (*Cardiospermum grandiflorum*), cats claw creeper (*Macfadyena unguis-cati*), spike rush (*Juncus acutus*), small-leaved privet (*Ligustrum sinense*), water hyacinth (*Eichhornia crassipes*), and bitou bush (*Chrysanthemoides monilifera subsp. Rotunda*).

In 2005 it was estimated that some 193 km or 56% of riverbanks were mapped with common to heavy infestations of one or more Category 1 weed species. **Illustration 3.4** to **Illustration 3.6** shows the distribution of common to heavy infestations of Category 1 weeds as mapped in 2005 and the results of additional mapping of the extent of *Juncus acutus* as mapped in Birch and GeoLINK (2010).

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*

*Information shown is for illustrative purposes only*




North

0 2 km

# Riparian Weeds - Subregion A

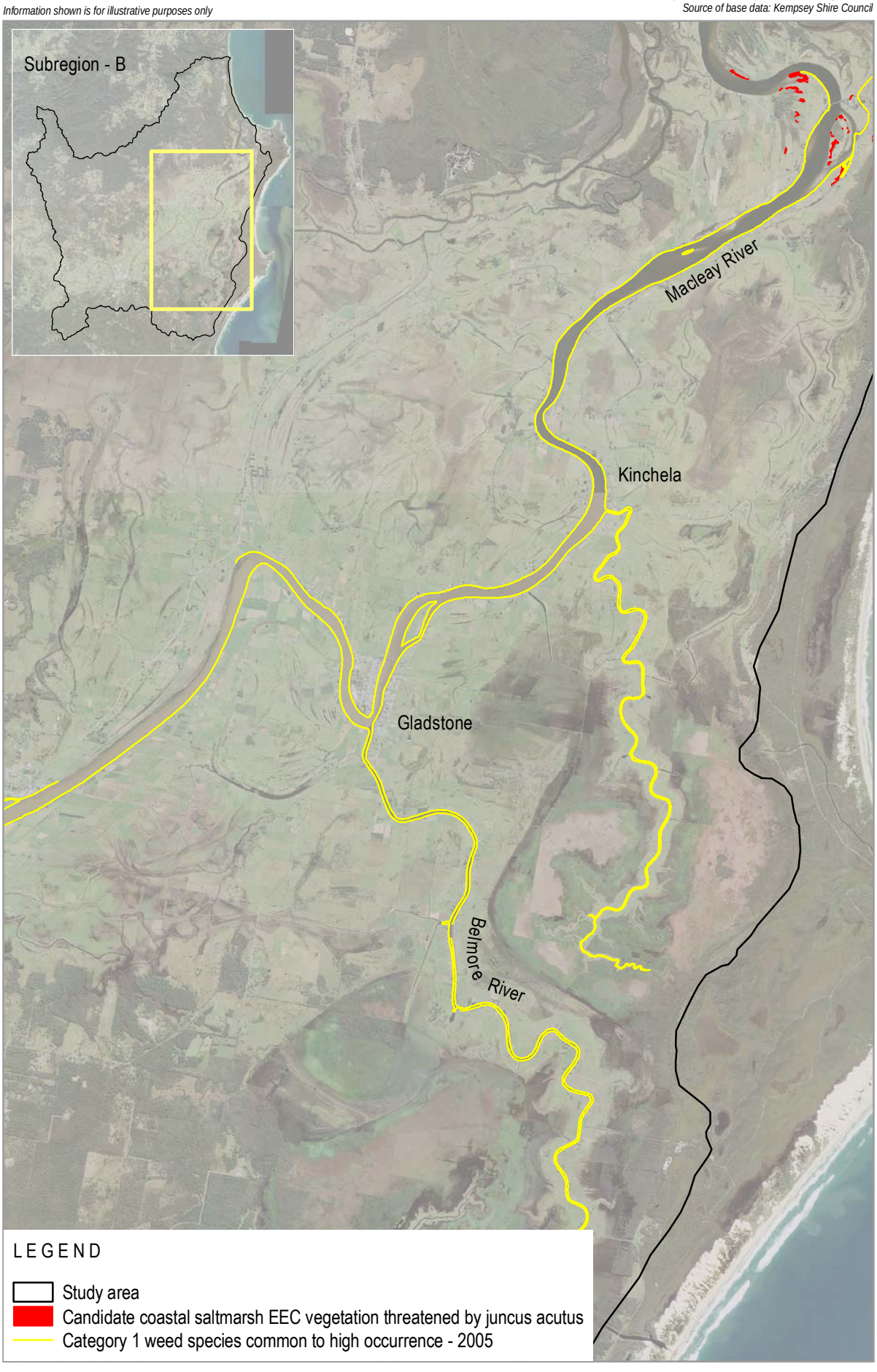
GeoLINK environmental management and design

Macleay River Estuary Management Study
1352227

Illustration 3.4

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*




North

0 2 km

# Riparian Weeds - Subregion B

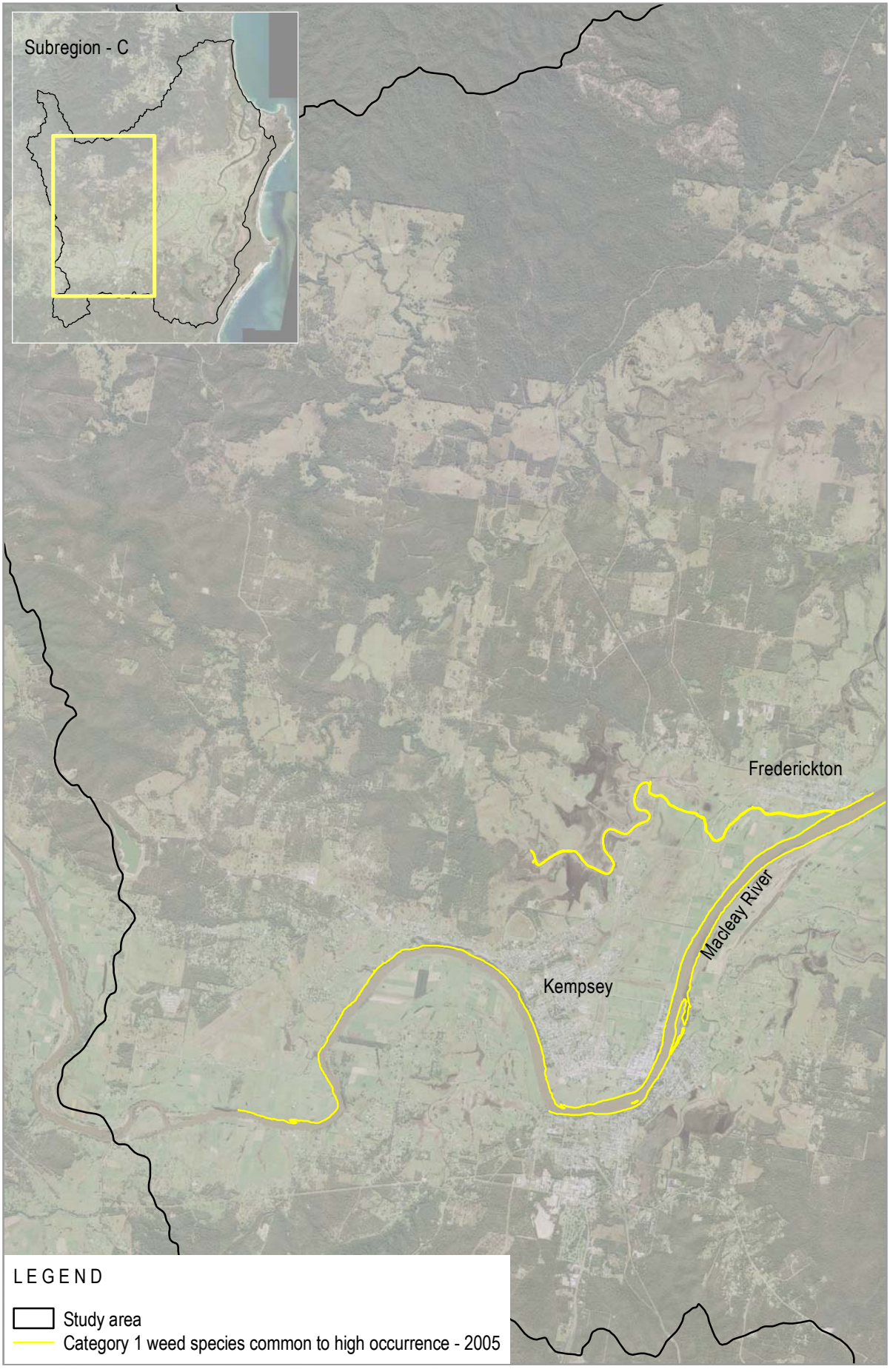
GeoLINK environmental management and design

Macleay River Estuary Management Study
1352228

Illustration 3.5

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*

*Information shown is for illustrative purposes only*




North

0 2 km

# Riparian Weeds - Subregion C

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352229

Illustration 3.6

### 3.1.4 Riparian Remnants and High Value Vegetation Types

The location and extent of riparian and floodplain vegetation remnants have been mapped using various methodologies over the past 10-15 years including:

- Forest ecosystems and candidate endangered ecological communities (EEC) under the Kempsey East Vegetation Mapping Project (Telfer and Kendall, 2006);
- Preliminary mapping of Littoral Rainforest EEC, Lowland Rainforest EEC, Coastal Saltmarsh EEC, and Swamp Oak Forest EEC by ID Landscapes for the Macleay Estuary Data Compilation Study (GECO Environmental, 2005);
- Mapping of estuarine vegetation types including seagrass, saltmarsh and mangroves by DPI Fisheries in 2006;
- Mapping of floodplain wetlands by WetlandCare Australia 2006;
- Mapping of SEPP14 and SEPP26 (Department of Planning).

Importantly, eight EEC were identified as potentially occurring on or adjacent to the Macleay estuary by ID Landscape Management in 2005. **Illustration 3.7** to **Illustration 3.9** shows the location of significant riparian vegetation types and potential floodplain remnants associated with estuarine or backswamp systems.

Condition assessments of riparian remnants have not been undertaken. However an estimate of condition may be inferred from the vegetation assessments undertaken by ID Landscape Management in 2005. This has been done by comparing reaches of potential remnant with the riparian condition assessments and level of weed infestation, including areas of mangrove forest and of coastal saltmarsh not affected by *Juncus acutus* infestation. **Illustration 3.10** to **Illustration 3.11** highlights areas that are inferred by this methodology to be potentially high value remnant riparian vegetation. It is recommended that site assessments be undertaken to determine the actual status of the vegetation communities identified.

### 3.1.5 Previous Erosion and Riparian Management Works

A wide range of bank erosion and riparian rehabilitation works have been implemented over the past 80 years in the Macleay with the vast majority of works being rock walls/revetment undertaken in the flood mitigation era (i.e. post the 1949/1950 floods and into the late 1970s). The following statistics detail the range of bank protection works identified during a survey of works undertaken as part of the Macleay Estuary Data Compilation Study (GECO Environmental, 2005);

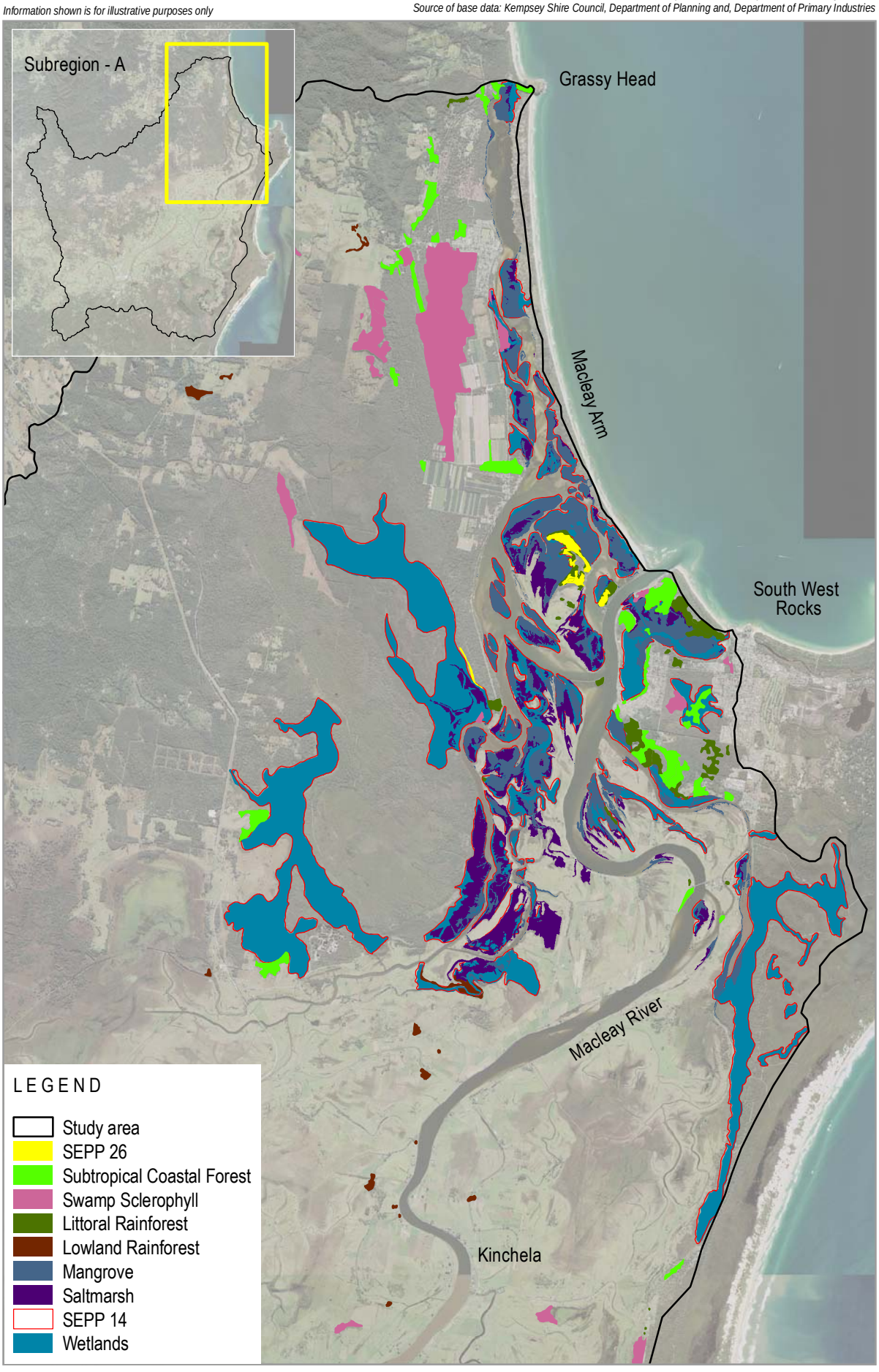
- brush groyne or log/timber bank protection (160m total on Macleay River and Clybucca Creek);
- revegetation and fencing on riverbanks (1500m total on Macleay River and Clybucca Creek, plus an additional 450m at two sites at Jerseyville undertaken since the 2005 survey);
- rock fillets / embayments (2 sites on Macleay River between Kinchella and Jerseyville);
- wave energy curtains constructed of various materials (Fatorini Island);
- tyre walls (approximately 900m in Kinchella Creek, Macleay Arm and Macleay River);
- reprofiling of banks in combination with revegetation (upper Macleay River estuary); and
- standard rock revetment (70.6km with the 55km on Macleay River, 13km on Clybucca Creek/Andersons Inlet, 960m on Macleay Arm, 750m on Spencers Creek, 500m on Belmore River, and 400m on Kinchella Creek).

**Illustration 3.12** to **Illustration 3.14** shows the distribution of known rehabilitation sites within the Macleay estuary as of 2005.

*Drawn by: RE Reviewed by: MVE Date: August 2010*

*Information shown is for illustrative purposes only*

*Source of base data: Kempsey Shire Council, Department of Planning and, Department of Primary Industries*




0 2 km

North

## Riparian Vegetation Types and Floodplain Remnants - Subregion A

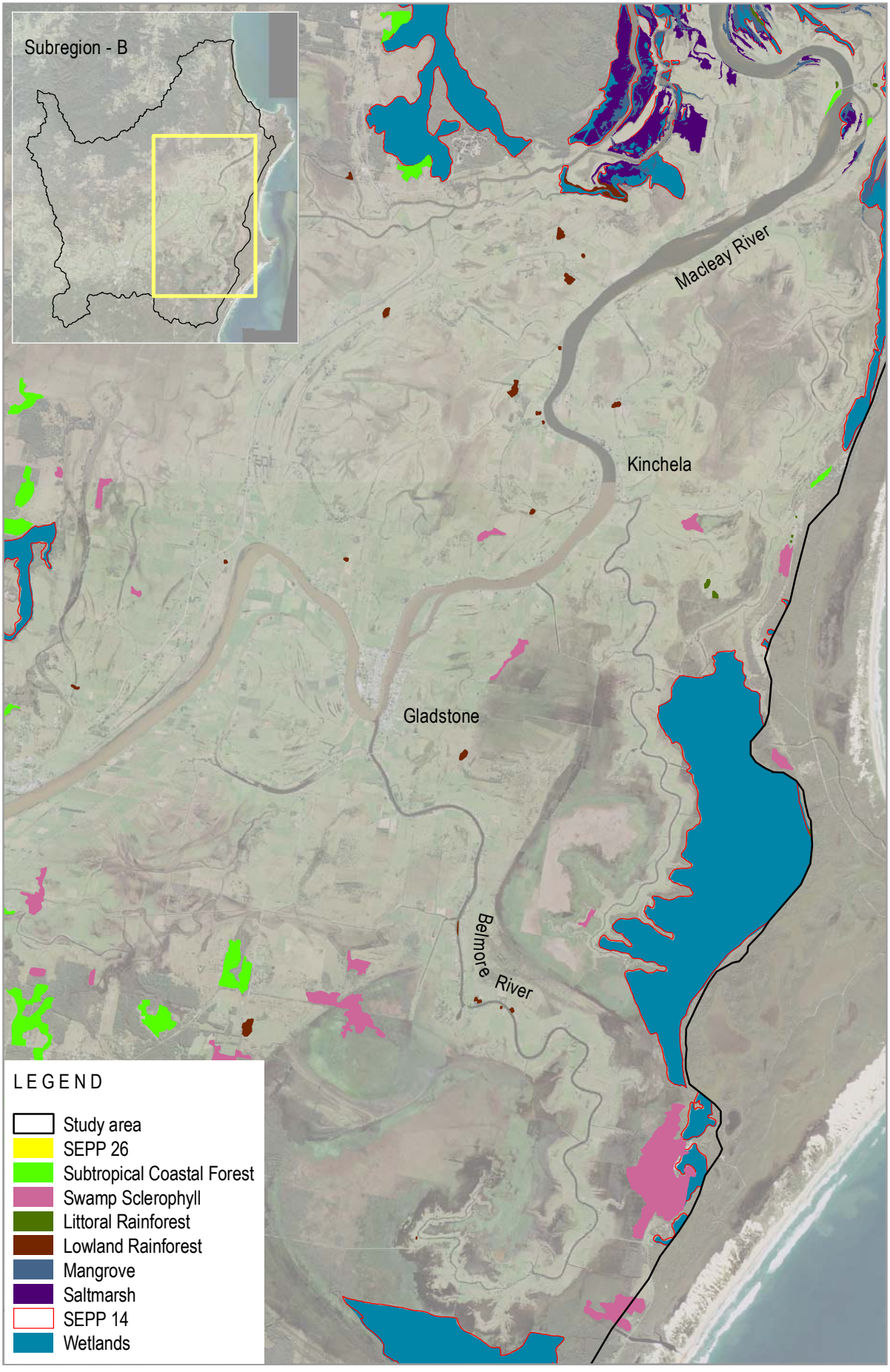
GeoLINK environmental management and design

Macleay River Estuary Management Study
1352230

Illustration 3.7

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*

*Information shown is for illustrative purposes only*




0 2 km

North

## Riparian Vegetation Types and Floodplain Remnants - Subregion B

GeoLINK environmental management and design

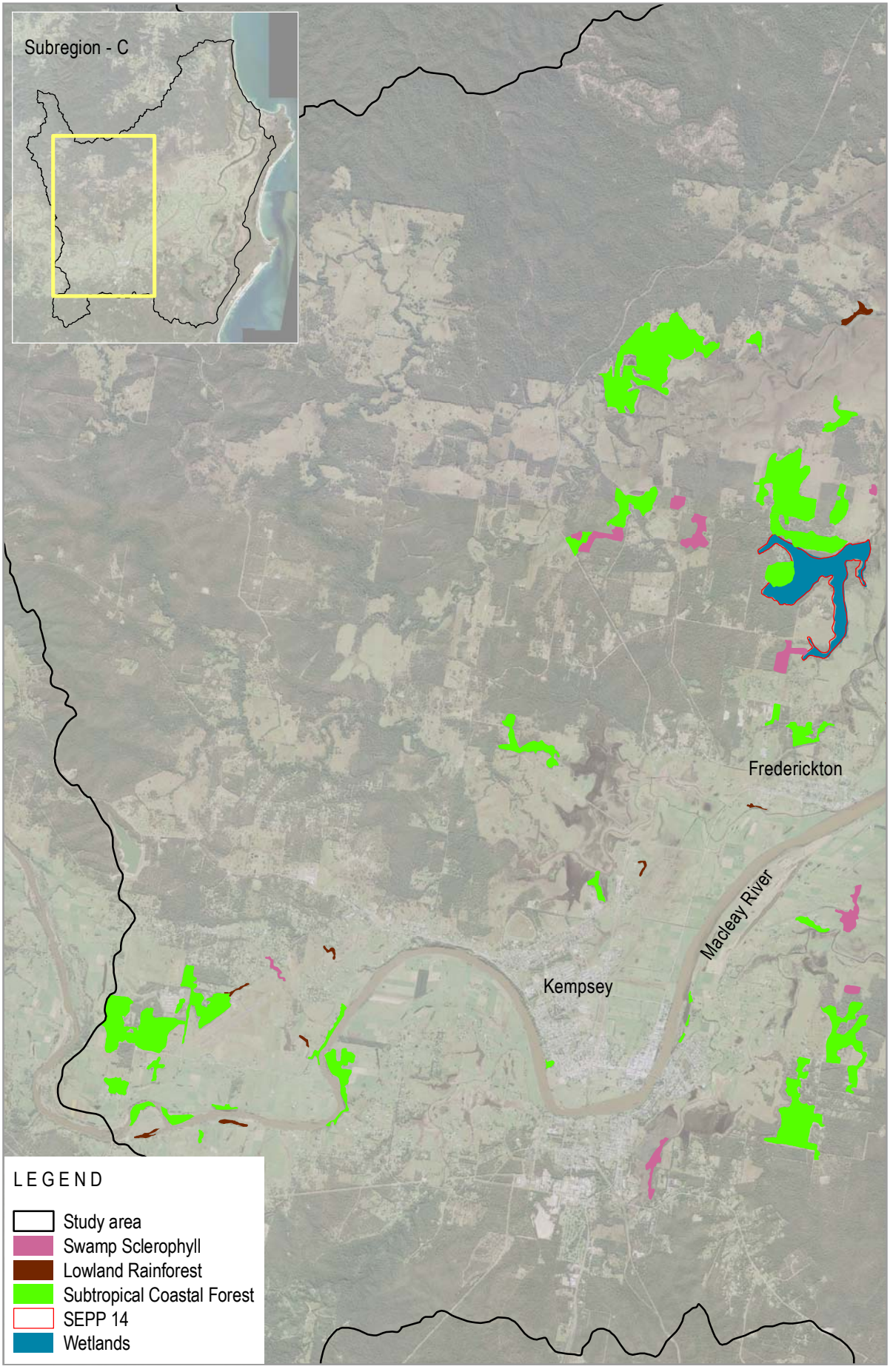
Macleay River Estuary Management Study
1352231

Illustration 3.8

Drawn by: RE Reviewed by: MVE Date: August 2010

Source of base data: Kempsey Shire Council, Department of Planning and, Department of Primary Industries

*Information shown is for illustrative purposes only*




0 2 km

North

## Riparian Vegetation Types and Floodplain Remnants - Subregion C

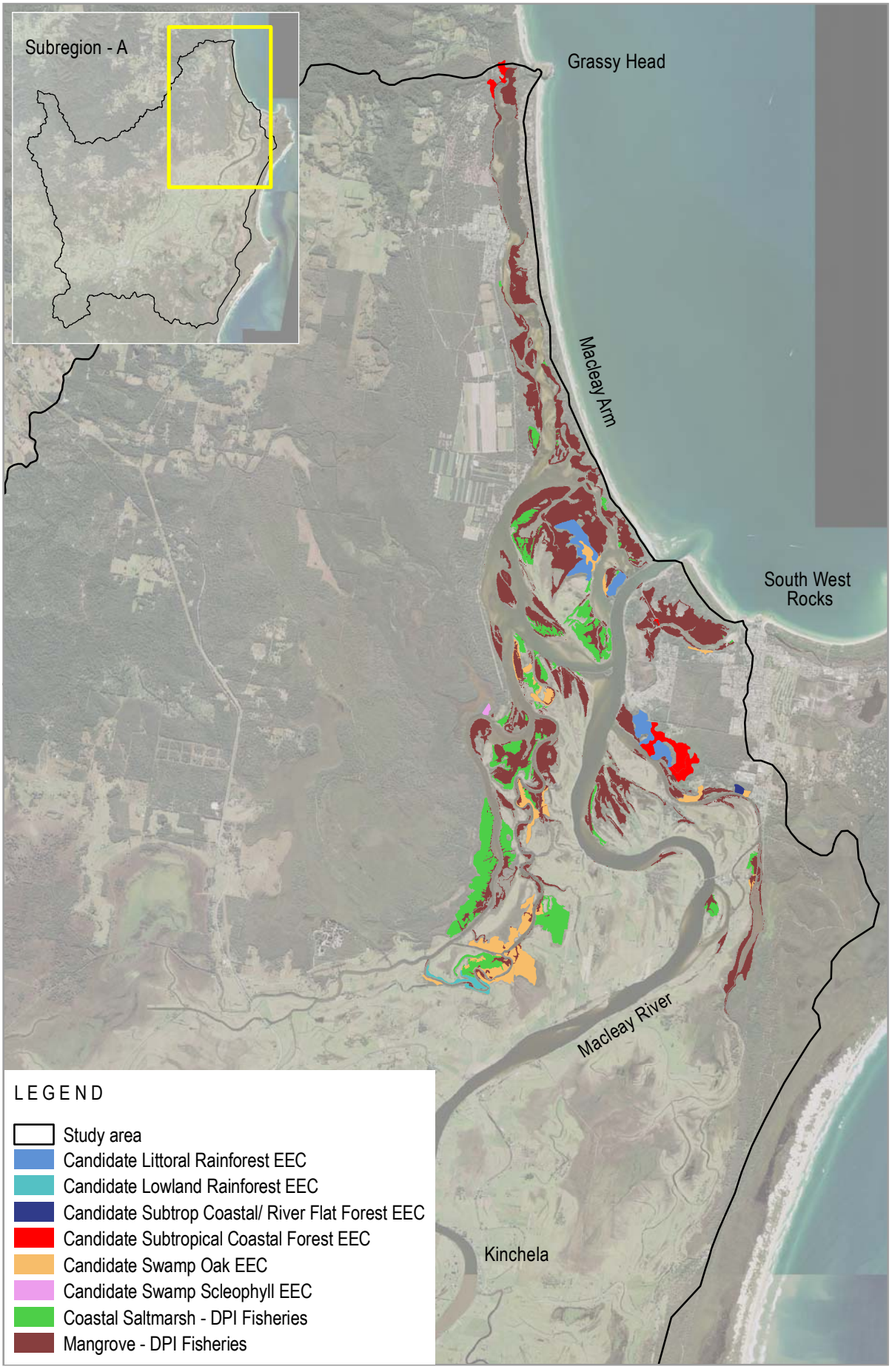
GeoLINK environmental management and design

Macleay River Estuary Management Study
1352232

Illustration 3.9

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*




0 2 km

North

## High Value Remnant Riparian Vegetation - Subregion A

GeoLINK environmental management and design

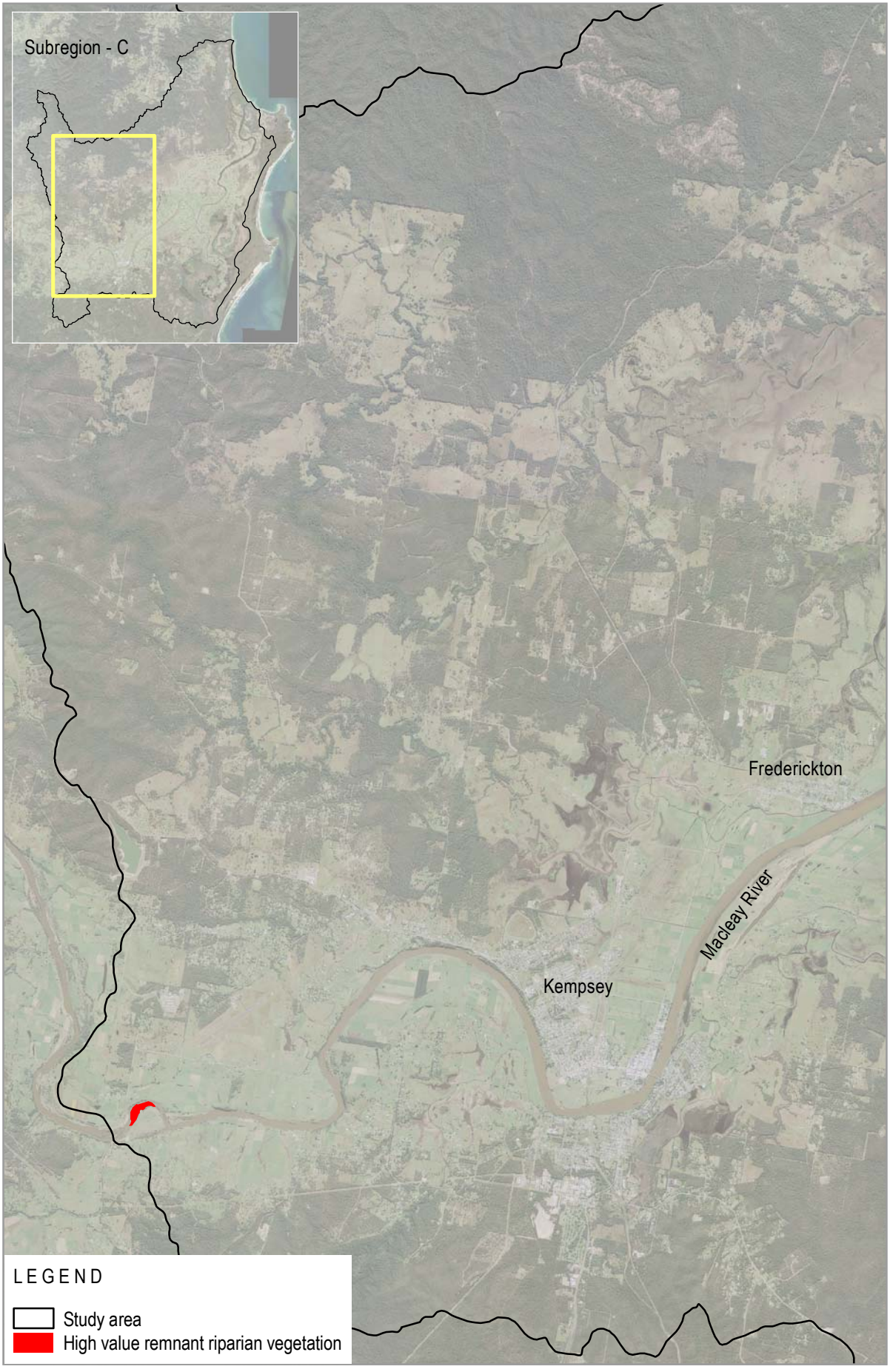
Macleay River Estuary Management Study
1352233

Illustration 3.10

Drawn by: RE Reviewed by: MVE Date: August 2010

Source of base data: Kempsey Shire Council, Department of Planning and, Department of Primary Industries

*Information shown is for illustrative purposes only*




0 2 km

North

## High Value Remnant Riparian Vegetation - Subregion C

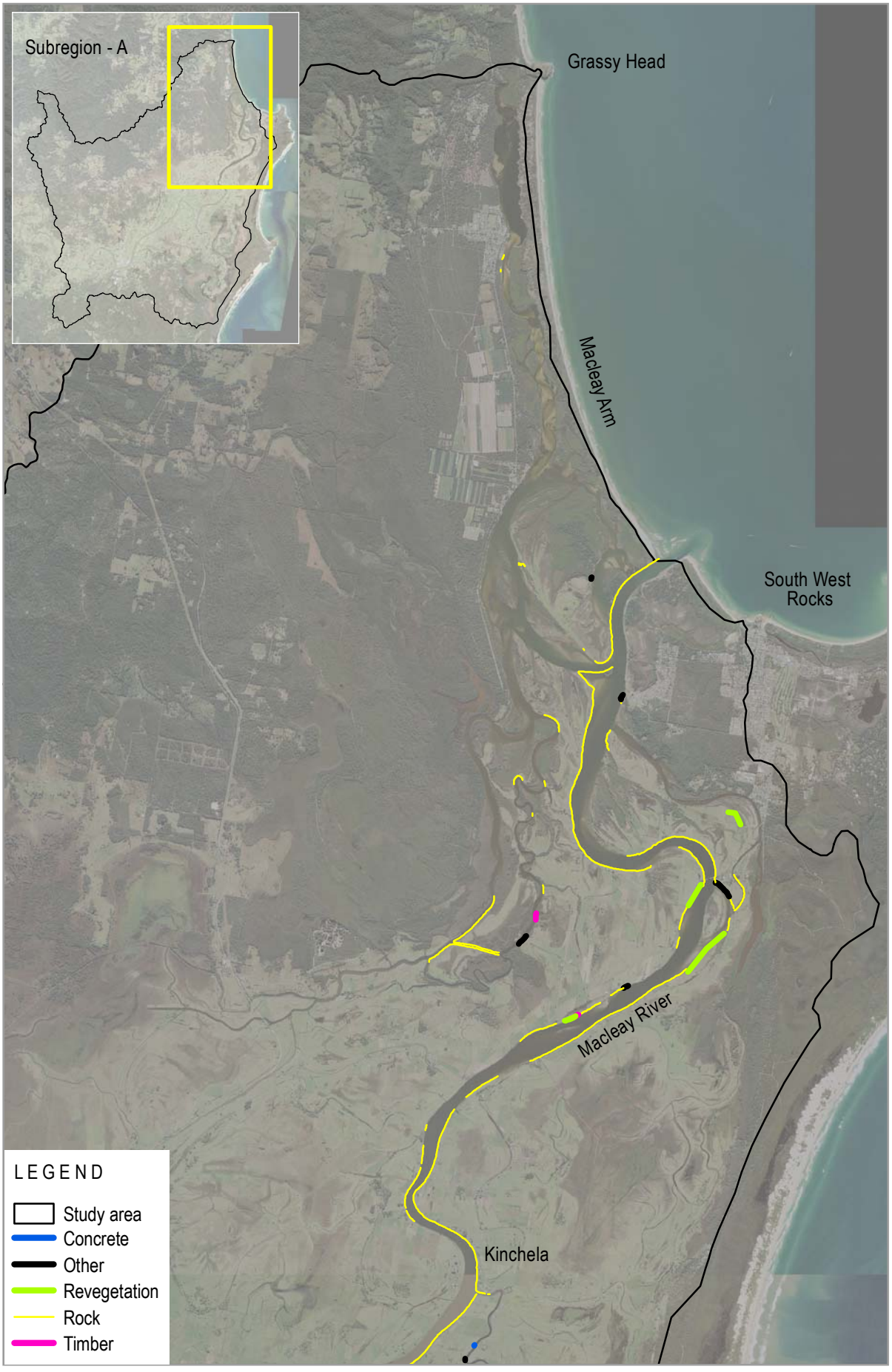
GeoLINK environmental management and design

Macleay River Estuary Management Study
1352235

Illustration 3.11

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*

*Information shown is for illustrative purposes only*




0 2 km

North

## Previous Erosion and Riparian Management Works - Subregion A

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352237

Illustration 3.12

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*

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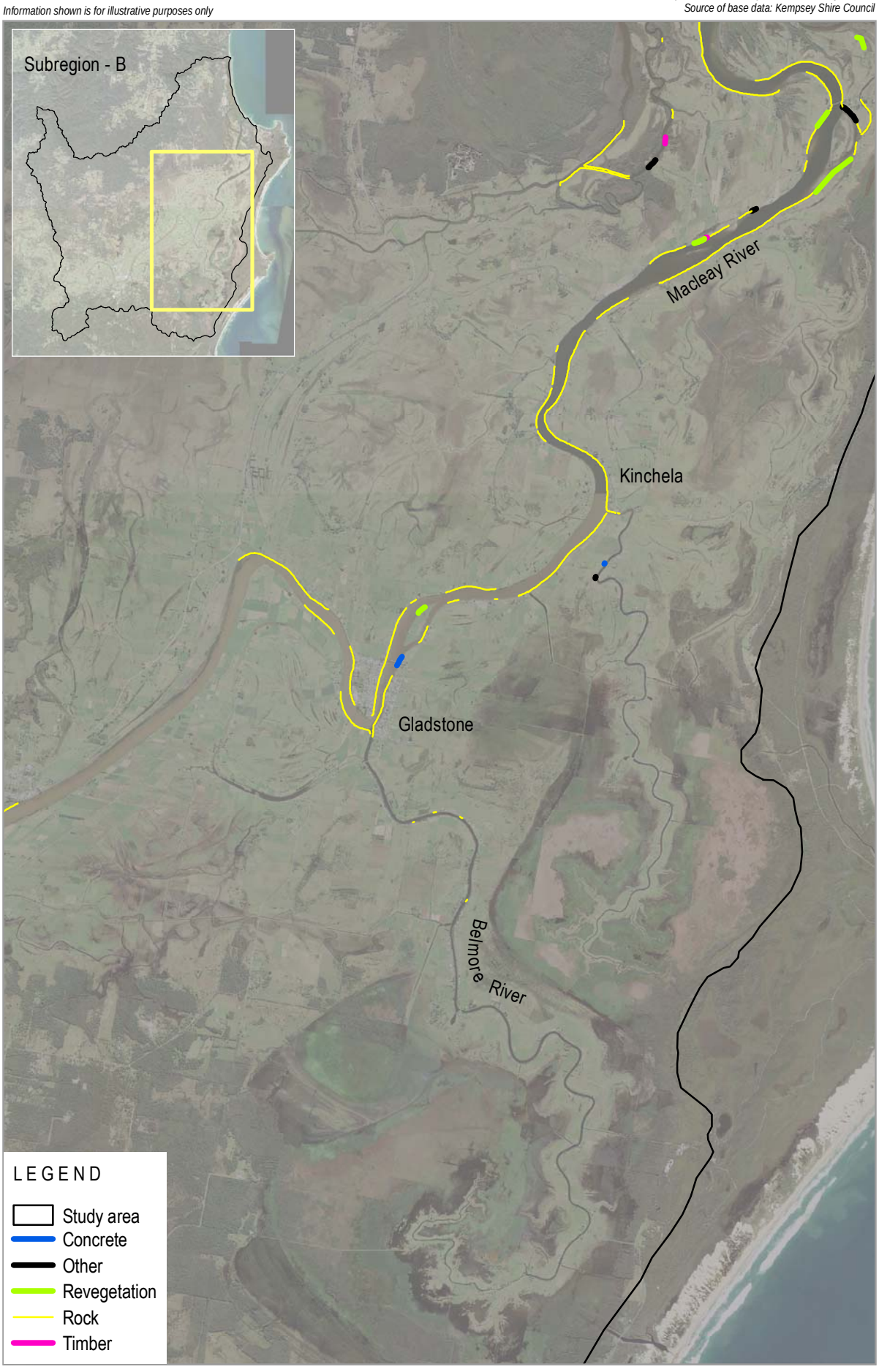


0 2 km

North

## Previous Erosion and Riparian Management Works - Subregion B

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352238

Illustration 3.13

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*

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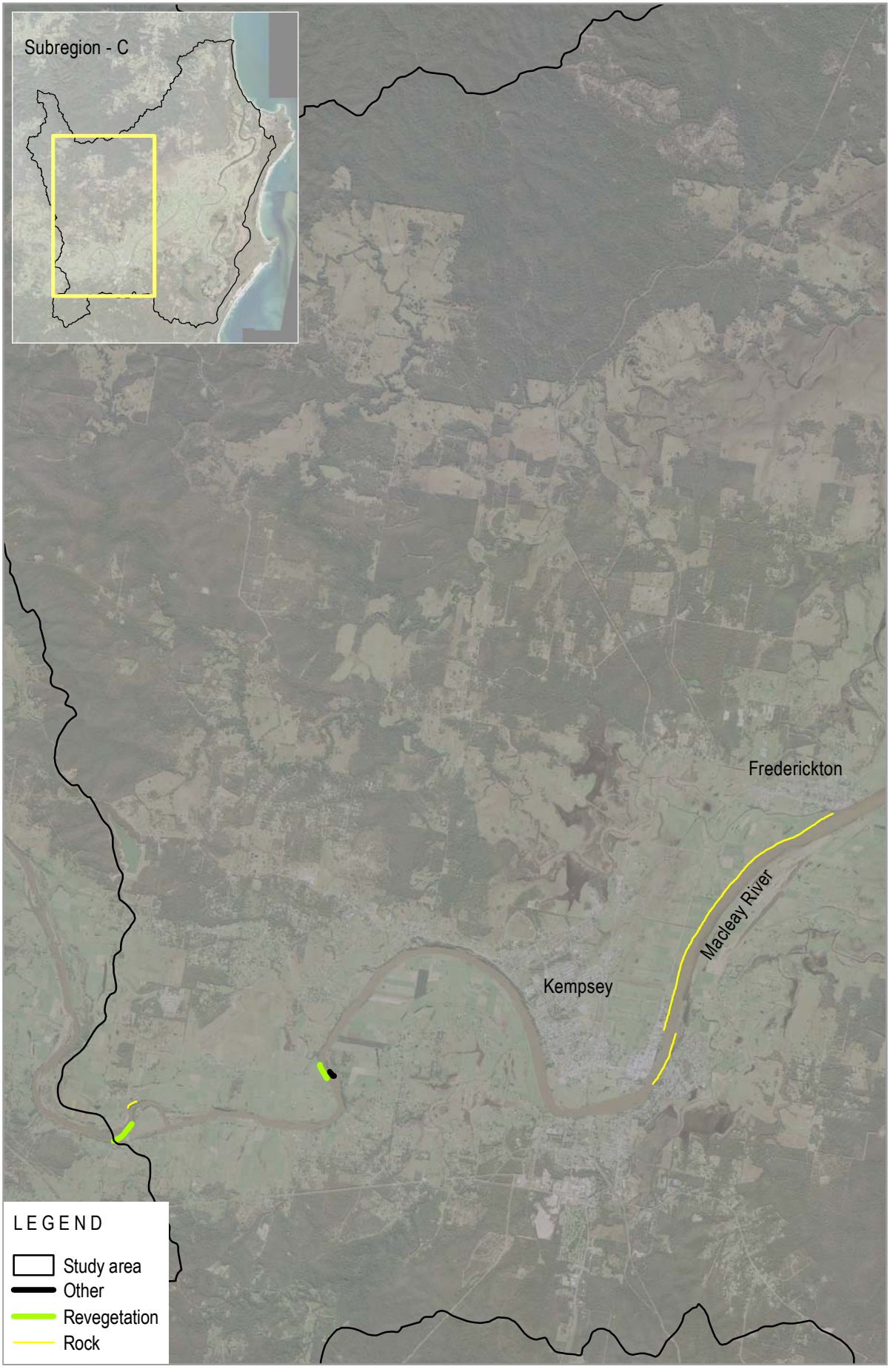


0 2 km

North

**Previous Erosion and Riparian Management Works - Subregion C**

Of interest, in recent years there have been several trials of low cost 'soft-engineering' style solutions to bank erosion in the estuary. These include the use of wave energy curtains using shadecloth and geofabric suspended from lengths of PVC to limit wave wash, and the use of low brush groynes also to limit wave wash. The rationale behind the trial of such methods is twofold: firstly to find a cheap and easily implemented alternative to hard options such as rock revetment, and secondly to reduce the impact of revetment style structures on the ecologically important interface between the waterway and the banks. Unfortunately both methods have proved to have limited effectiveness over the medium to long term in arresting bank erosion (J. Schmidt 2010, pers. comm. 19 February).

Examples of current best-practice bank protection works will be provided in the Macleay River Estuary Management Plan and include:

1. natural regeneration / stock control;
2. rock revetment / revegetation; and
3. rock embayments / fillets / revegetation.

## 3.2 Management Issues

### 3.2.1 Bank Erosion Management Issues

Bank erosion management issues have been identified using a number of sources including the Macleay Estuary Data Compilation Study; consultation with Council, DECCW, CEMC and other stakeholders; and the consultant team's own observations. The management issues include:

- The loss of valuable riverside land;
- Increased turbidity and sedimentation in the estuary as a result of bank erosion;
- Costs and ongoing maintenance of erosion protection works;
- A lack of native riparian vegetation along the banks of the Macleay River;
- The extensive use of rock revetment as the main treatment for bank protection resulting in a significant change in river bank associated habitat; and
- Undesirable riverbank treatment associated with riverside urban development.

### 3.2.2 Riparian vegetation management issues

Riparian vegetation management issues have been identified using a number of sources including the Macleay Estuary Data Compilation Study; consultation with Council, DECCW, CEMC and other stakeholders; the consultant team's own observations; and the ecological study undertaken by Birch and GeoLINK (2010). Issues particularly relevant to riparian habitats include:

- The Macleay River 'riparian corridor' is highly degraded due to the extent of clearing and the paucity of remnant pockets along the riparian margin or in pockets across the floodplain. Weed infestations are extensive. Nevertheless the riparian margin does act as a conduit for a variety of mobile species;
- The extent of Category 1 weed infestation in the Macleay estuary, and the significant difficulties and costs associated with attempting to eradicate these weeds from even small areas of infestation poses difficult questions for management in terms of dealing with the weed issue;
- Degradation of remnant vegetation due to landuse disturbances, weed incursion, and vulnerability to bank erosion (particularly in relation to saltmarsh communities in wave wash zones); and
- Disturbance associated with unmanaged stock access to the banks and riparian areas.

The management of these threats will form a key component to the long-term protection and restoration of the riparian corridor. Ideally an entire riparian corridor would be restored and protected. However, due to the substantially modified state of large portions of the riparian zone along the estuary, best practice management is to undertake such works at priority sites.

## 3.3 Management Objectives

### 3.3.1 Guiding Principles for Bank and Riparian Management

It can be seen from the data presented above and the illustrations showing the distribution of bank erosion and riparian management issues in the Macleay catchment that, as with many other NSW north coast estuaries, there are more river management issues than there are resources available to resolve them. As a result, a system for setting priorities is necessary if the available resources are to be used as effectively as possible to improve overall estuary health.

From a purely river health perspective, the highest priority should be given to protection of reaches in good condition by removal of threatening processes, and implementation of appropriate rehabilitation and preventative actions in easily restored or high value reaches. However, it is recognised that many of these reaches are on private land which, depending on circumstances, may limit the practical implementation of any management actions.

From the same perspective, undertaking rehabilitation works solely in reaches that are in poor condition should be avoided as such works are: likely to have little effect on the overall health of the system; are likely to be high cost and high risk; and may take up valuable resources that may be better utilised preventing areas in good condition from becoming degraded.

Whilst, these principles form a logical framework for assisting the priority setting process, it is recognised that other factors such as social, economic, cultural, and political considerations also play influential roles in estuary management decisions. For example, the protection of important community assets such as roads, bridges or boating facilities are obvious examples of where social and economic considerations may override river health objectives.

### 3.3.2 Setting Priorities for Bank Protection

In accordance with the principles outlined above, the following priorities are suggested for bank protection works:

- **Highest Priority**
  Sites where bank erosion threatens existing community infrastructure or property, or high value ecological systems including riparian and remnant vegetation;
- **High Priority**
  Sites where bank protection or riparian management works have already been implemented but where on-going erosion or other identified disturbance factors are threatening the works and future stability of the banks and/or values of the site;
- **Moderate Priority**
  Sites where erosion is considered to be serious but where significant and ongoing commitment is required by both landholders and responsible government agencies and funding bodies. Many moderate priority sites have very poor riparian vegetation and ongoing disturbance factors such as wind or boat wave wash or impacts from unmanaged stock access. These factors would need to be addressed in any erosion mitigation strategy to justify expending resources on these sites;
- **Low Priority**
  All remaining reaches assessed in the 2005 field surveys of bank erosion and riparian vegetation are considered to be low priority in terms of consistency with the guiding principles outlined above.

It is recommended that the priorities be reviewed periodically. For instance, flood events, changes to estuary use, or the construction of new public infrastructure adjacent to the estuary may result in a reassessment of the priorities presented.

**Illustration 3.15** to **Illustration 3.17** shows the locations of the 'Highest Priority' and 'High Priority' sites for bank erosion management identified using the prioritisation process detailed above (based on 2005 survey data).

### 3.3.3 Setting Priorities for Riparian Management

In accordance with the principles outlined above, the following priorities are suggested for riparian management:

- **Highest Priority**
  Sites where erosion or weed invasion (particularly by Category 1 weed species) threaten existing high value ecological systems including riparian and remnant vegetation or important riparian corridor linkages.
- **High Priority**
  Sites where bank protection, riparian management works or landholder management agreements have already been implemented to protect high value riparian or remnant vegetation but where on-going erosion or other identified disturbance factors are threatening the values of the site.
- **Moderate Priority**
  Sites where riparian or remnant vegetation values are already considerably compromised by historic and/or ongoing land use management practices or significant weed incursion, and where a considerable ongoing commitment would be required by both landholders and responsible government agencies and funding bodies.
- **Low Priority**
  All remaining reaches assessed in the 2005 field survey of riparian vegetation are considered to be low priority in terms of consistency with the management principles outlined above.

**Illustration 3.18** shows the locations of Highest Priority sites for riparian management in the Macleay River estuary identified using the above prioritisation process (based on limited 2010 updating of the 2005/2006 survey data). The Highest Priority sites for riparian management are all located in the lower portion of the estuary (Subregion A).

### 3.3.4 Bank and Riparian Management Objectives

Based on the principles and priorities discussed above, the following series of objectives for management of bank erosion and riparian vegetation in the Macleay estuary have been developed:

| | |
|---|---|
| ***Management Objective 3/1*** | Protect existing public infrastructure threatened or vulnerable to bank erosion; |
| ***Management Objective 3/2*** | Protect important riparian conservation values where threatened by bank erosion, weed invasion, or land management practices; |
| ***Management Objective 3/3*** | Protect existing bank and riparian management works; |
| ***Management Objective 3/4*** | Utilise best-practice erosion control, riparian management techniques and flood mitigation works to improve overall estuary health; |
| ***Management Objective 3/5*** | Improve the condition and continuity of the riparian corridor; |
| ***Management Objective 3/6*** | Manage recreational boat use in areas of high vulnerability / susceptibility to wave wash erosion. |

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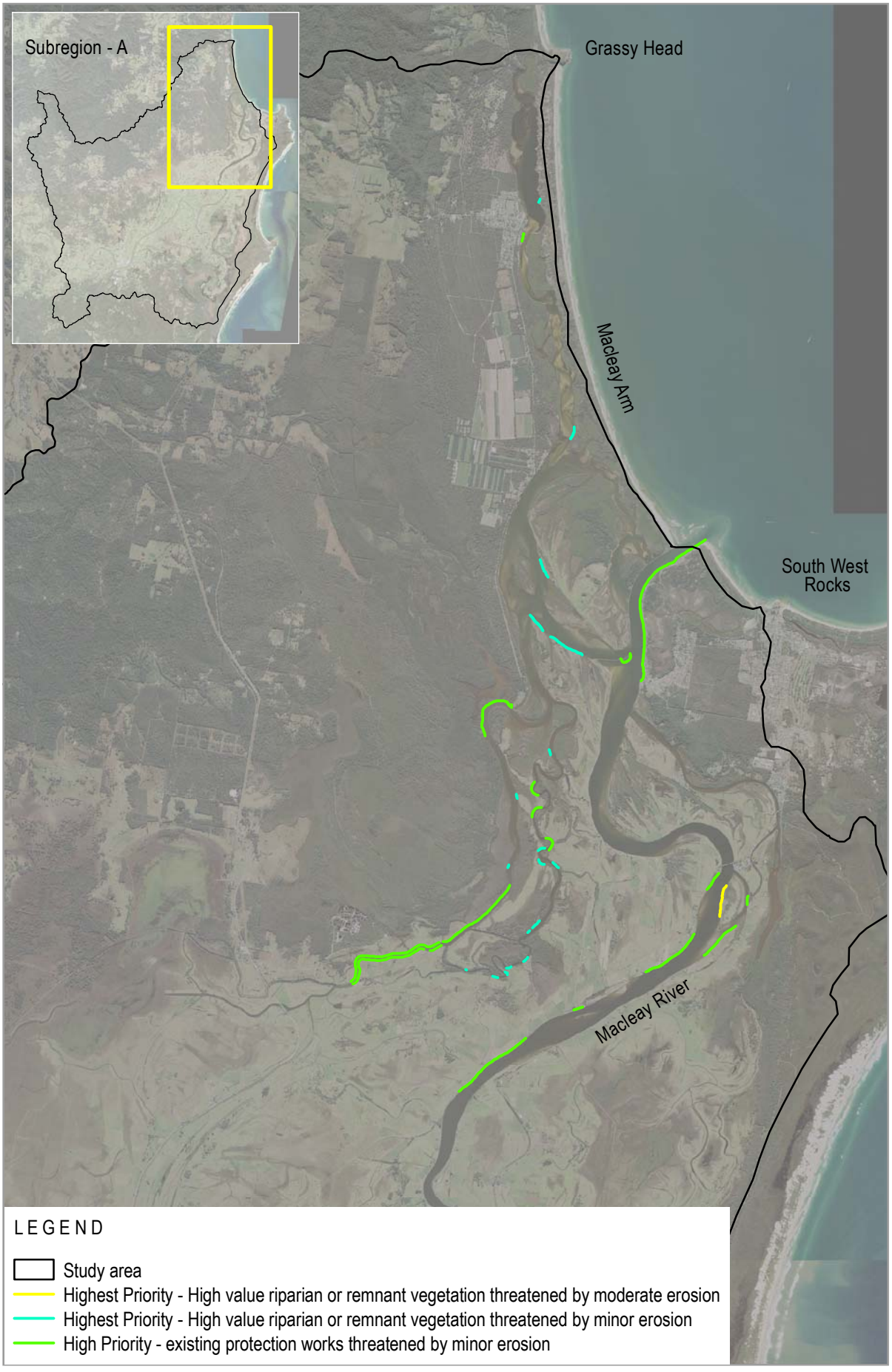
*Source of base data: Kempsey Shire Council*




North

0 2 km

**Highest and High Priority Sites for Bank Erosion Management - Subregion A**

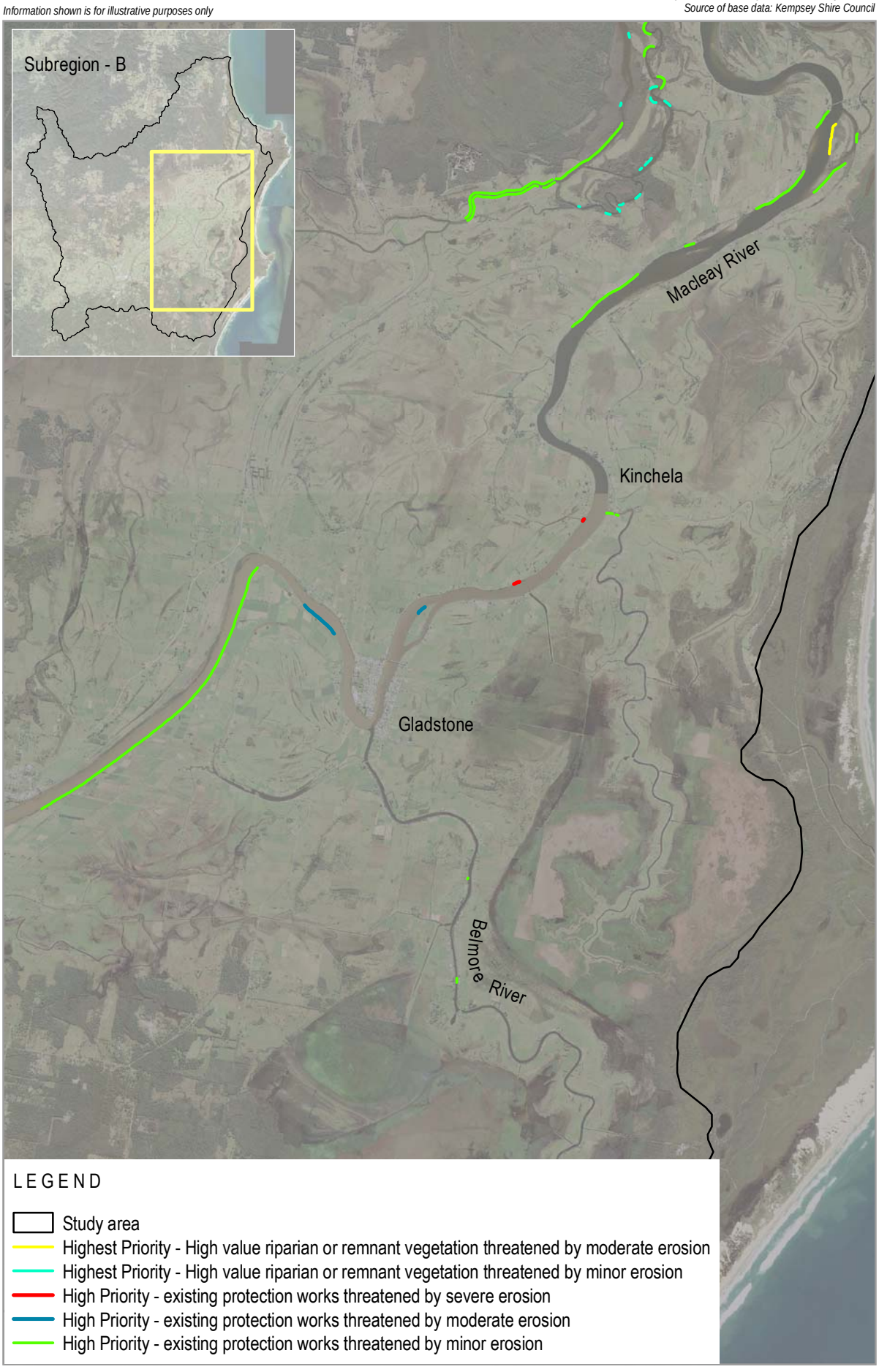
GeoLINK environmental management and design

Macleay River Estuary Management Study
1352241

Illustration 3.15

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*

*Information shown is for illustrative purposes only*




North

0 2 km

**Highest and High Priority Sites for Bank Erosion Management - Subregion B**

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352242

Illustration 3.16

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*

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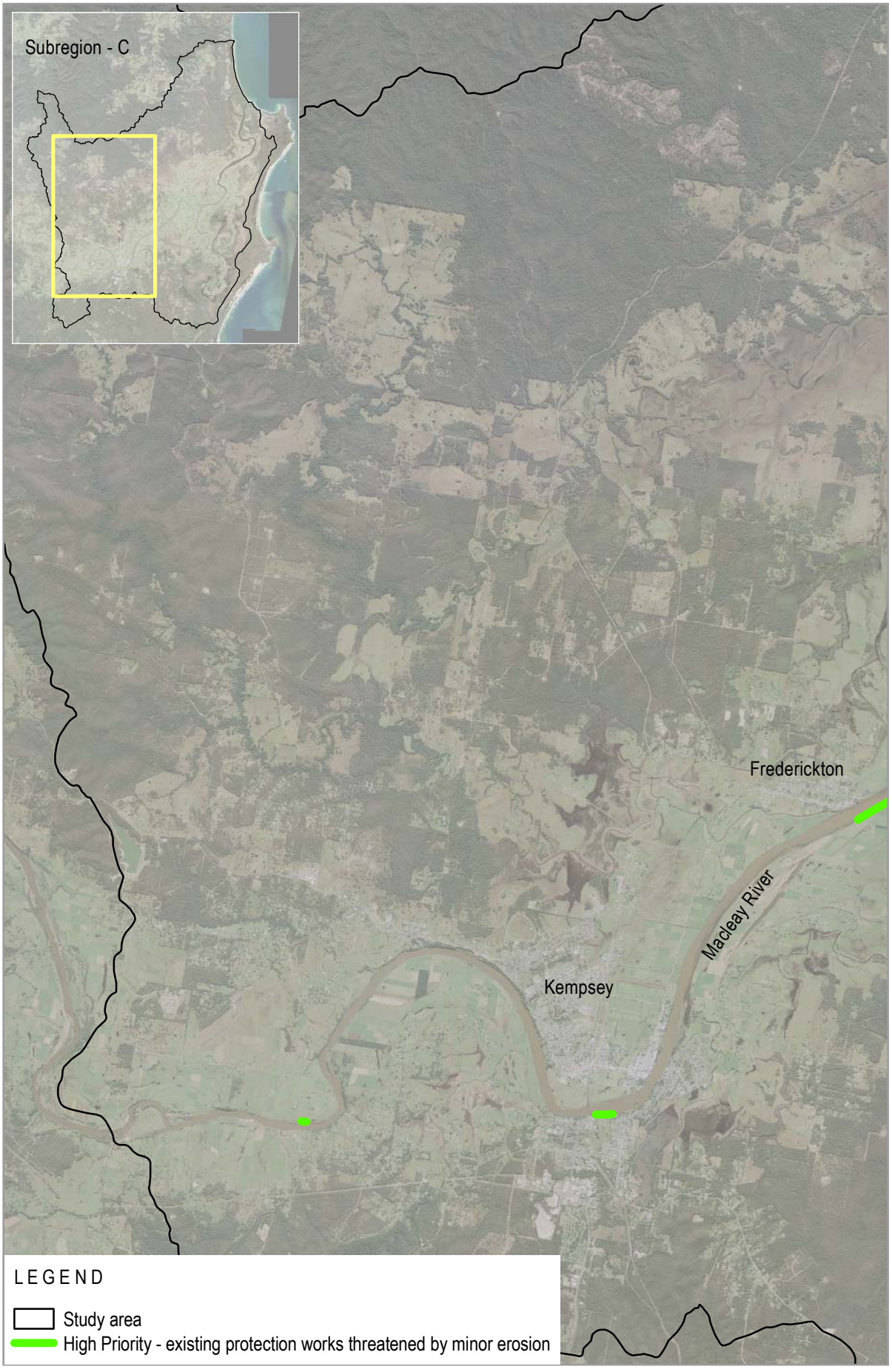



0 2 km

North

## Highest and High Priority Sites for Bank Erosion Management - Subregion C

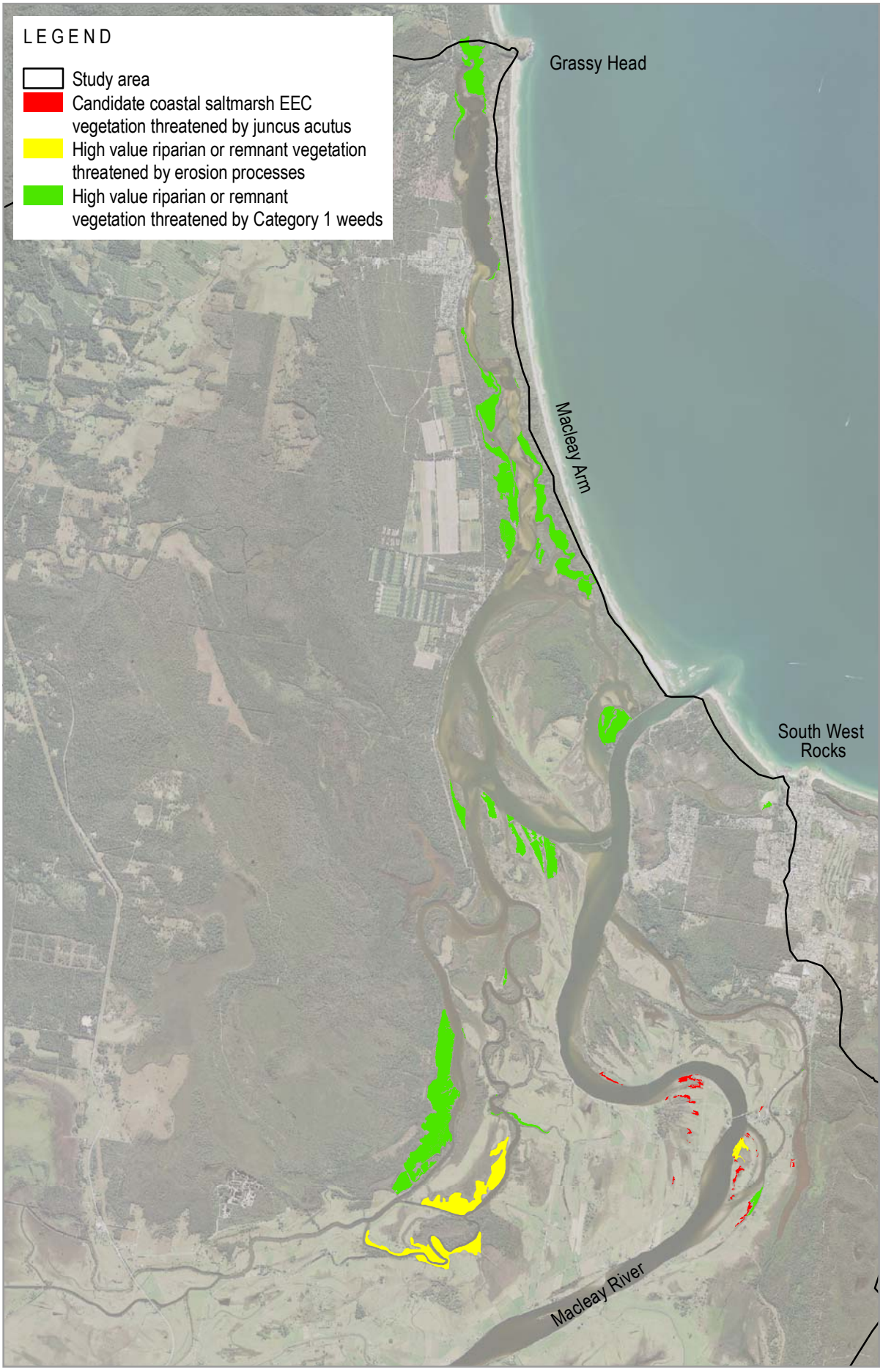
GeoLINK environmental management and design

Macleay River Estuary Management Study
1352243

Illustration 3.17

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*




0 1.5 km

North

## Highest Priority Sites for Riparian Management

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352244

Illustration 3.18

## 3.4 Management Strategies

### 3.4.1 Protect Existing Public Infrastructure

***Summary:*** Roads, bridges, and other infrastructure such as boat ramps and public access ways are particularly at risk from damage during flood events. Using the available 2005 survey data there were no sites identified where public infrastructure was at risk from either severe or minor erosion. It is recognised, however, that the 2009 floods may have caused some damage to estuary related public infrastructure. Where this is the case, actions to remediate erosion in these areas are justified on the basis of early intervention saving many thousands of dollars of damage and so such works can generally be considered to have a high benefit to cost ratio.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Identify sites where bank erosion is impacting public infrastructure (eg. public bridges, wharves, jetties, boat ramps.) | 3/1<br>3/3 | No sites have been identified based on 2005 data However, ongoing post-flood assessment by KSC, LPMA and NSW Maritime is recommended. |
| Identify most suitable remediation techniques utilising best-practice erosion control guidelines. | 3/1<br>3/4 | KSC, DECCW, NRCMA, |
| Seek funding as required | 3/1 | KSC, DECCW Estuary program |
| Implement works according to best-practice guidelines | 3/1 | KSC or suitably qualified contractor |

### 3.4.2 Protect Important Riparian Conservation Values

***Summary:*** Coastal saltmarsh EEC, littoral rainforest EEC, swamp sclerophyll forest ECC, mangrove communities, and remnant riparian forests are just some of the high value ecosystems that occur within the Macleay River estuary. With the exception of mangrove forests, the distribution of many vegetation communities has been significantly reduced over the past 150 years (GECO Environmental, 2005). Protection of any remaining remnants should therefore be a priority for erosion and riparian management. Sites identified through the prioritisation process discussed in **Section 3.3.3** are shown in **Illustration 3.18**.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Identify sites with important riparian conservation values | 3/2<br>3/5 | Identified in this EMS (see **Illustration 3.18**) |
| Undertake site assessment to identify the most appropriate protection/remediation techniques. Issues to be addressed may include weed management, land use management practices. This will be undertaken for three of the highest priority sites as part of the Estuary Management Study | 3/2<br>3/4<br>3/6 | KSC, DECCW, DPI Fisheries (saltmarsh), NRCMA, Landcare, or specialist bush regeneration contractors |
| For public lands seek funding as required.<br>For private lands, seek landholder agreement and support under a suitable incentive scheme or funding arrangement. | 3/2 | KSC, DECCW Estuary program, NRCMA, Landcare, Landholders. |

| | | |
|---|---|---|
| Implement works according to best-practice guidelines | 3/2<br>3/4<br>3/5 | Suitably qualified bush regeneration contractors and landholders/public authorities where applicable. |

### 3.4.3 Protect Existing Bank and Riparian Works

***Summary:*** There are more than 72 km of estuary bank protection and riparian revegetation works in the study area representing a significant investment of effort and resources. Many sites require minor maintenance works to assist the ongoing rehabilitation of the sites. An initial investigation of sites requiring maintenance or further protection has been undertaken using the data available at the time of the commencement of this EMS. **Illustration 3.19** to **Illustration 3.21** shows the location of these sites, however further investigation through field inspection is recommended.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Identify existing bank or riparian works sites that require further protection or maintenance. | 3/1<br>3/3 | A preliminary list of sites has been generated for this EMS. However, further field investigation is recommended.<br>KSC, DECCW |
| Undertake site assessment to identify the most appropriate protection/remediation techniques. | 3/3<br>3/4<br>3/6 | KSC, DECCW |
| Seek funding as required | 3/3 | KSC, DECCW Estuary program, NRCMA. |
| Implement works according to best-practice guidelines | 3/4 | KSC or suitably qualified contractor |

### 3.4.4 Utilise best-practice erosion control, riparian management techniques and flood mitigation works

***Summary:*** This includes using appropriate materials, incorporating estuary health goals, and re-establishing native riparian vegetation.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Collate best-practice guidelines for erosion control, riparian management works and flood mitigation works | 3/4 | Examples of best-practice techniques will be provided in the final EMP document. The EMP document will also provide site specific concept design illustrations for three of the highest priority areas. |
| Incorporate best practice management (BPM) into conditions where development approval is required for works. | 3/4<br>3/5 | KSC, DECCW |
| Restrict funding access for projects not implementing BMP techniques. Implement works according to best-practice guidelines | 3/4<br>3/5 | DECCW, NRCMA |

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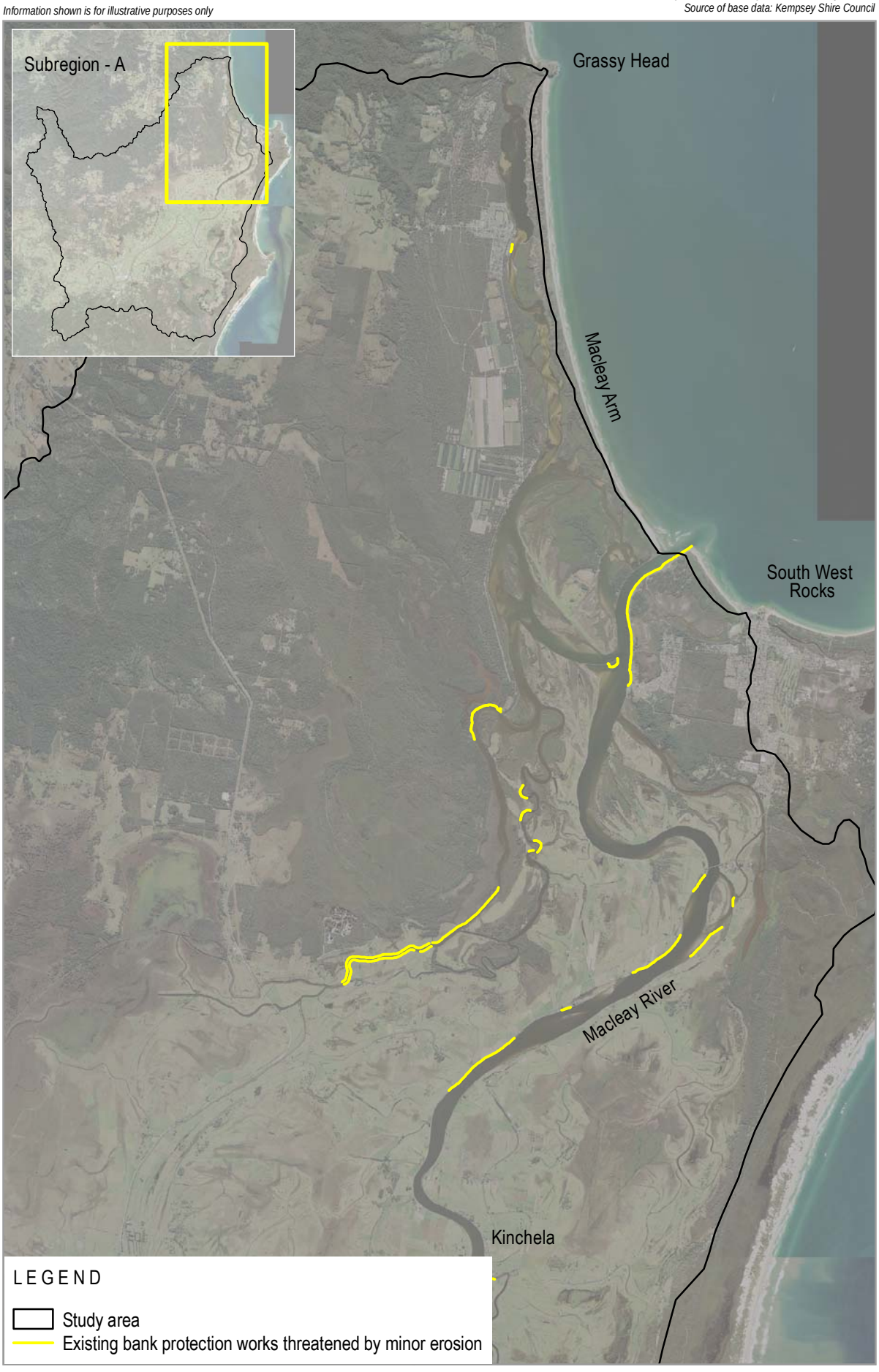
*Source of base data: Kempsey Shire Council*

*Information shown is for illustrative purposes only*




0 2 km

North

## Existing Bank and Riparian Works Requiring Maintenance - Subregion A

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Macleay River Estuary Management Study
1352247

Illustration 3.19

*Information shown is for illustrative purposes only*

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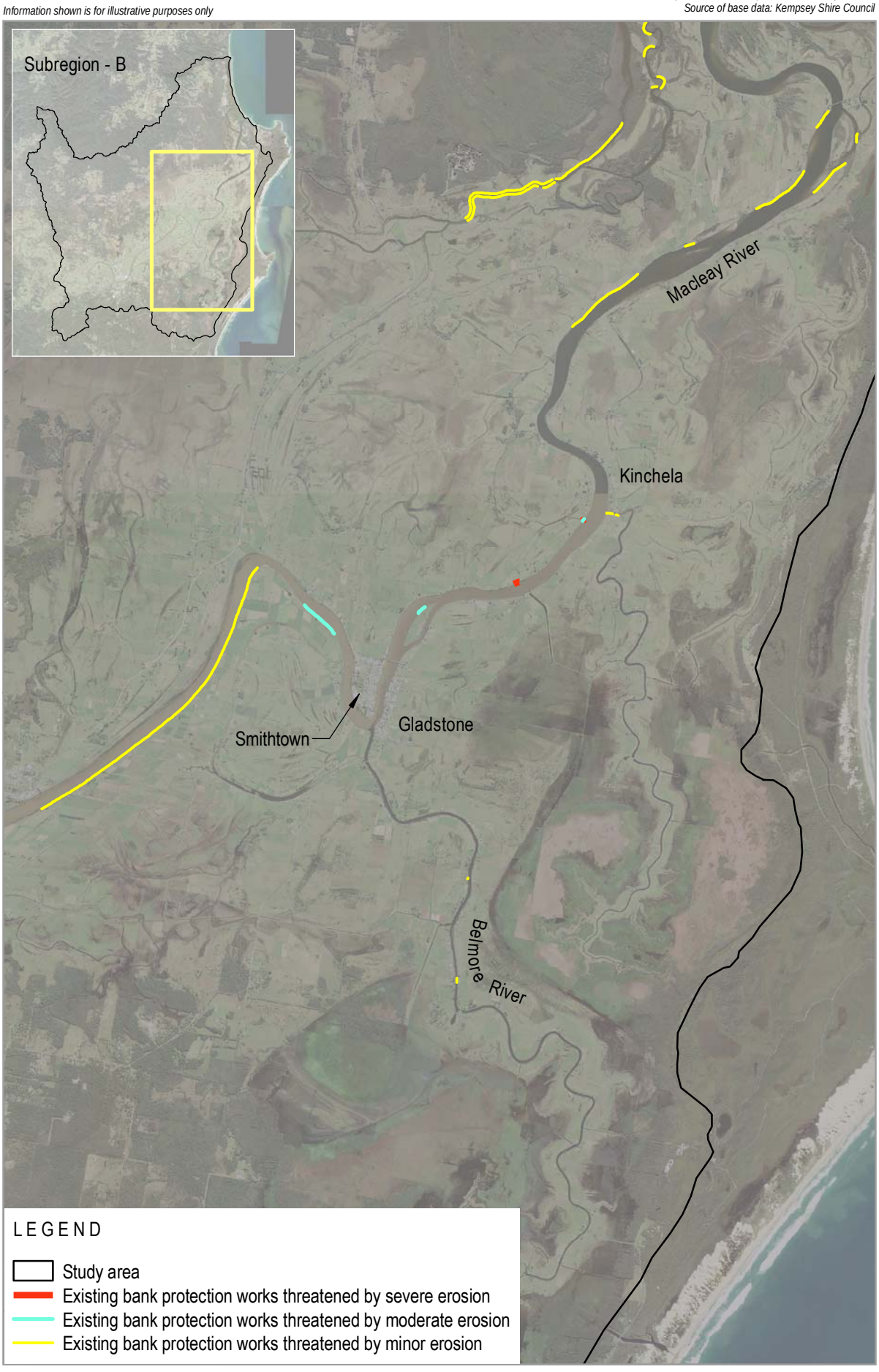
*Source of base data: Kempsey Shire Council*




0 2 km

North

## Existing Bank and Riparian Works Requiring Maintenance - Subregion B

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352248

Illustration 3.20

*Information shown is for illustrative purposes only*

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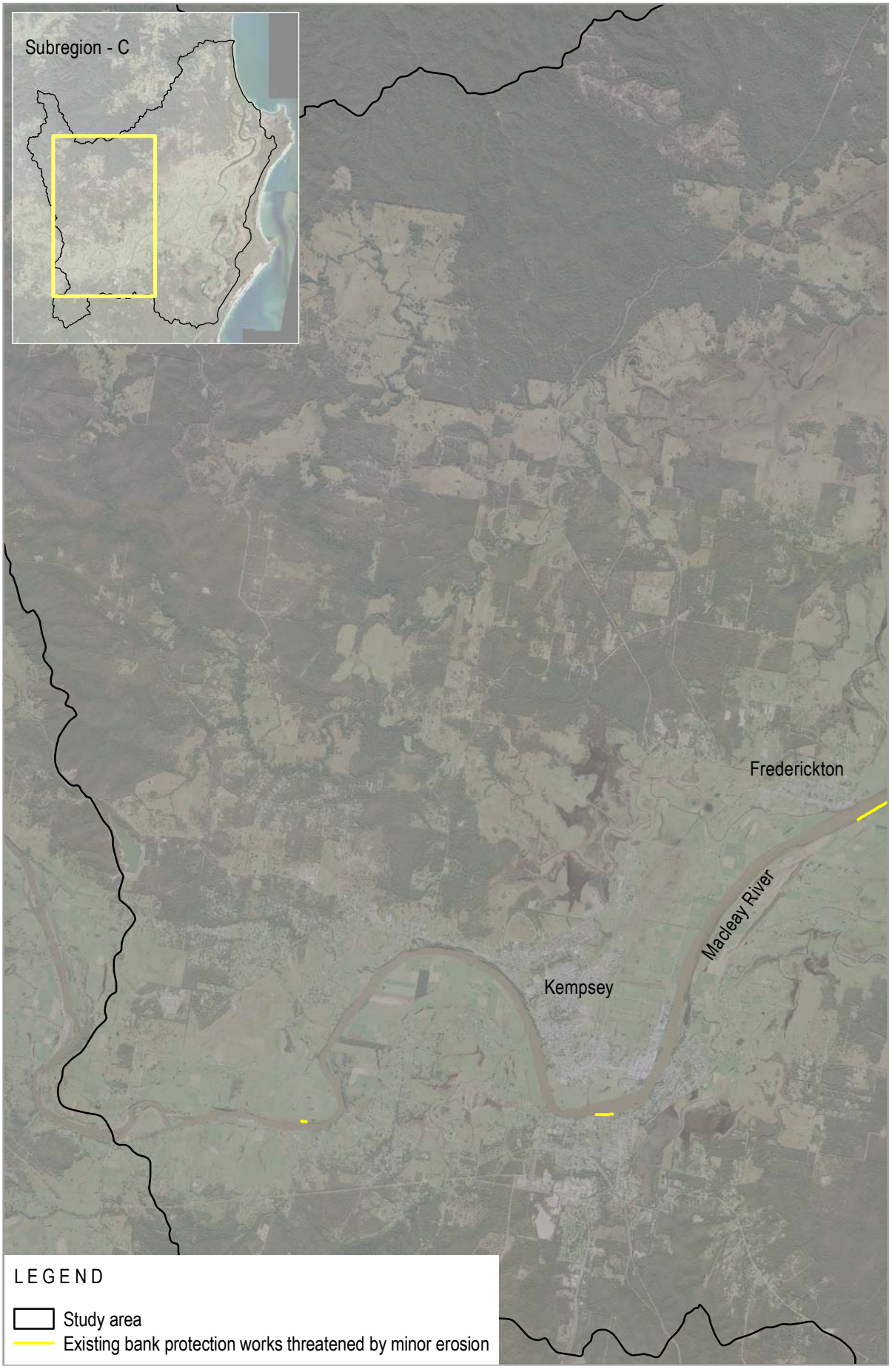
*Source of base data: Kempsey Shire Council*




North

0 2 km

## Existing Bank and Riparian Works Requiring Maintenance - Subregion C

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352249

Illustration 3.21

### 3.4.5 Improve the condition and continuity of the riparian vegetation

***Summary:*** Outside of areas where rock bank protection works have been implemented there is a high correlation between the presence/absence of structurally diverse native riparian vegetation and absence/presence of bank erosion. This suggests that in order to decrease erosion rates in the estuary it will be necessary to improve the condition of riparian vegetation. Removing disturbance factors such as unmanaged stock access and controlling invasive environmental weeds (such as madiera vine, coastal morning glory, coral trees, etc) can assist natural regeneration. However, considerable effort is required to achieve long-term success and follow-up maintenance is essential. The locations of reaches of riparian vegetation in good and very good condition are shown in **Illustration 3.10** to **Illustration 3.11**. Incentive funding for landholders could be targeted towards these areas to ensure that they remain in good condition. Planning controls may also assist in this regard.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Develop an incentive funding program to facilitate broad-scale riparian improvement works in the estuary. | 3/4<br>3/5 | KSC, DECCW, NRCMA, and Landcare |
| Implement the incentive program. | 3/5 | Landcare |
| Develop conditions for leasehold land along the estuary foreshore that encourage best-practice riparian management including managed stock access, weed control, and native vegetation retention. | 3/5 | LPMA, KSC |
| Implement planning controls that encourage the retention and/or improvement of riparian vegetation along the estuary | 3/5 | KSC |

### 3.4.6 Manage recreational boat use

***Summary:*** There are a plethora of signs indicating boat speed limits in areas deemed susceptible to boat wash erosion in the lower reaches of the estuary. Despite this, there are still areas which are being impacted by boat wave wash. In particular, areas within the Macleay Arm and Clybucca Creek are currently being impacted (Geco Environmental, 2005). In other areas, the contribution of wind waves versus boat wave wash is less certain but boat wash is still likely to be a contributory factor (eg. Kinchella Bend).


Source: Cohen, 2005

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Improve and consolidate signage to reduce confusion | 3/1<br>3/3 | NSW Maritime, DECCW |
| Investigate the use of channel marker devices to keep boat users away from susceptible banks | 3/3<br>3/4<br>3/6 | NSW Maritime |
| Develop an education and awareness program to encourage local and visiting boat users to observe existing controls on boat speed and no wave wash zones. | 3/3 | NSW Maritime, DECCW |
| Enforce current speed regulations | 3/4 | NSW Maritime |

# 4 Floodplain Wetlands Management

## 4.1 Current Status

Floodplain wetlands are intrinsically connected to estuarine ecology and health and thus must be considered in the development of an Estuary Management Plan. Floodplain wetlands, in an undisturbed state, interact with the estuary in a number of ways (see Sheaves *et al*. 2006):

- floodplain wetland vegetation can deliver carbon in bioavailable forms to the estuary, increasing overall productivity;
- floodplain wetlands can provide habitat for many estuarine species and form an essential part of the life cycle of some estuarine species; and
- floodplain wetlands can retain and process catchment runoff, improving estuarine water quality and reducing the erosive forces associated with floodwaters.

Land clearing, drainage and flood mitigation works have changed floodplain wetlands and drastically altered their ecology. In addition, second and third order impacts of these changes have been experienced on the Macleay which may include (following Middleton 1989);

- the loss of renowned fishing sites;
- high levels of oyster mortality in wet years;
- fish kills; and
- declining prawn catches.

A significant number of respondents (44%) to the General Survey undertaken for the present study described the health of the Macleay backswamps as poor to very poor.

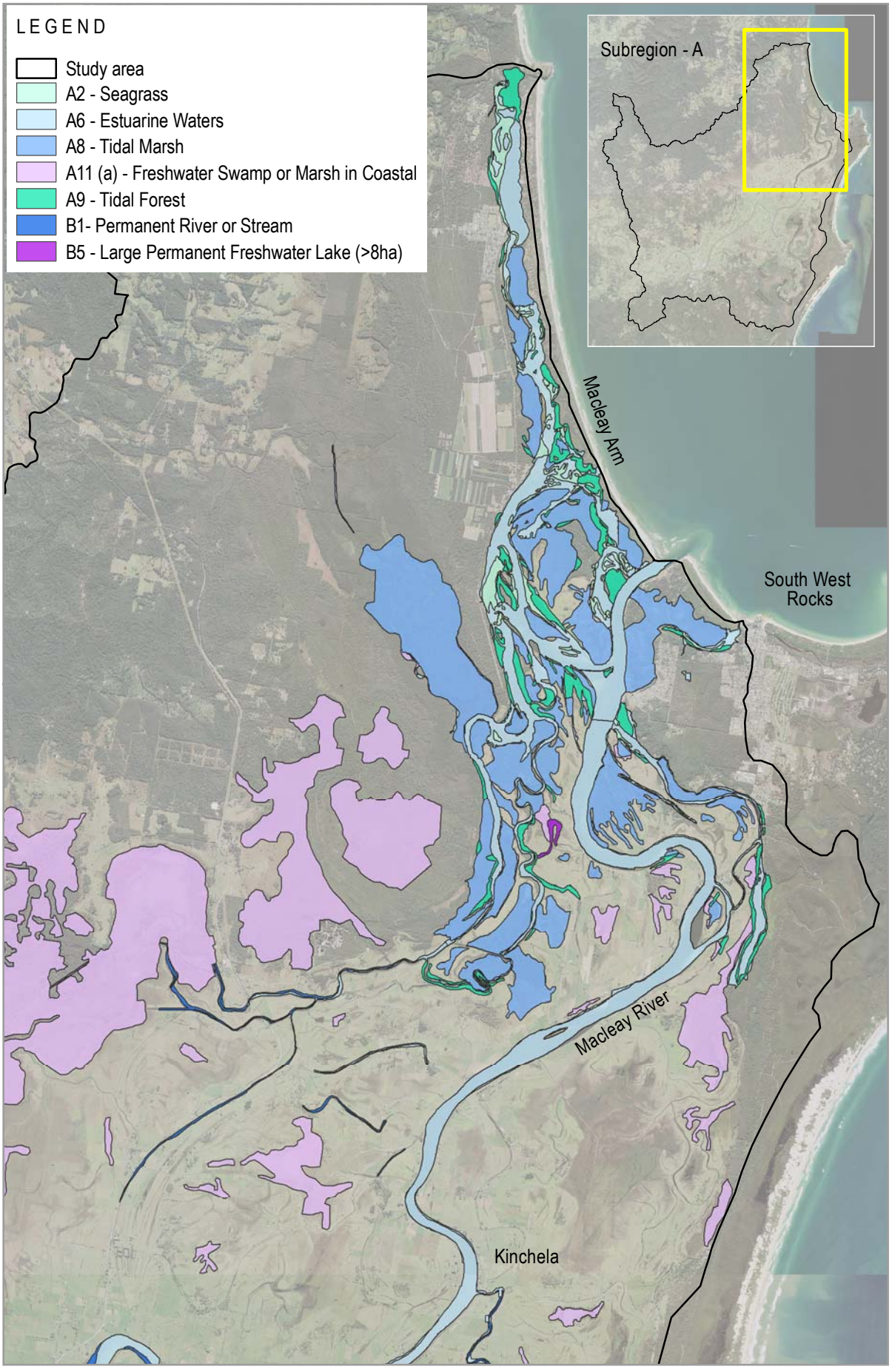
### 4.1.1 Wetland Extent and Distribution on the Macleay

There are a variety of maps of wetlands on the Macleay floodplain including maps produced by Pressey (1989), the North Coast Environment Council (NCEC, Parkhouse et al 1999) and Wetland Care Australia (WCA, Burns *et al*. 2006). The Wetland Care Australia maps have not been 'ground-truthed'. Each of the mapping sources differs in the methods used to define wetlands and, subsequently, the exact placement of wetland boundaries and the total extent of wetland area.

The extent of wetlands is difficult to describe, mainly due to differences in the perception of what constitutes a wetland. The most recent maps of the Macleay floodplain wetlands was produced by Wetland Care Australia as part of a program to map the extent of wetlands in the Northern Rivers Catchment area (Burns *et al*. 2006). These maps are included in this report as **Illustration 4.1, 4.2 and 4.3**. These maps were produced by compiling existing geospatial data from a variety of sources to define wetland areas and to classify them according to Directory of Important Wetlands in Australia (DIWA) guidelines. They also assigned conservation prioritisation attributes to mapped wetland areas using existing data. Notably, the WCA maps do not include the wetland areas known as East Kempsey Swamp, Frogmore and Raffertys. These areas form a significant part of the total wetlands on the Macleay floodplain and this is a significant oversight. There are also some erroneous errors in the wetland types for the areas of Kinchela Swamp. A stated aim of the WCA project is to update the maps as improved information becomes available and it is recommended as part of this EMS that these areas be included in any subsequent review or update.

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council and Wetland Care Australia*



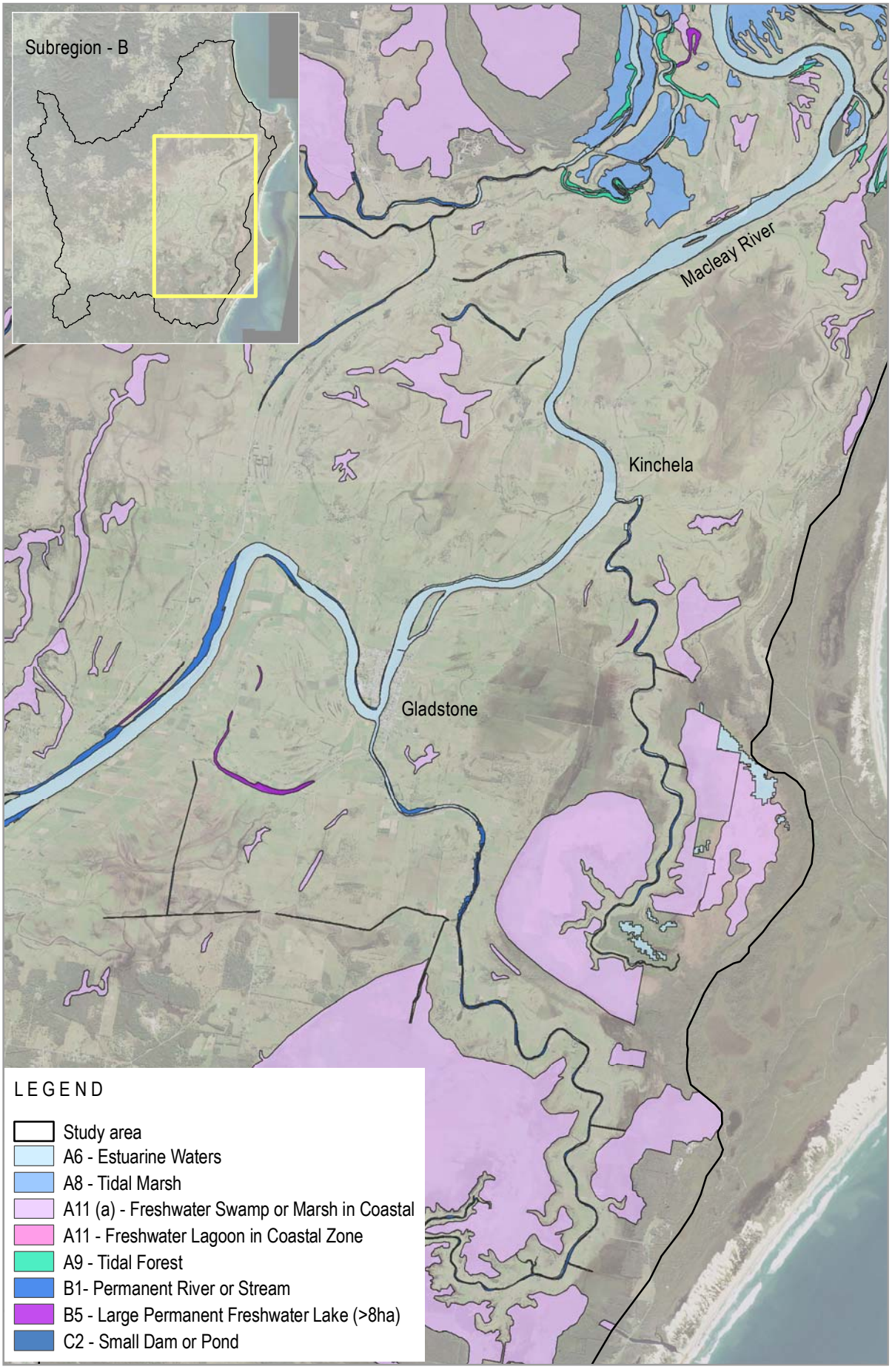

0 2 km

North

# Distribution of Wetlands within the Study Area - Subregion A

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council and Wetland Care Australia*




North

0 2 km

# Distribution of Wetlands within the Study Area - Subregion B

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Macleay River Estuary Management Study
1352716

Illustration 4.2

*Information shown is for illustrative purposes only*

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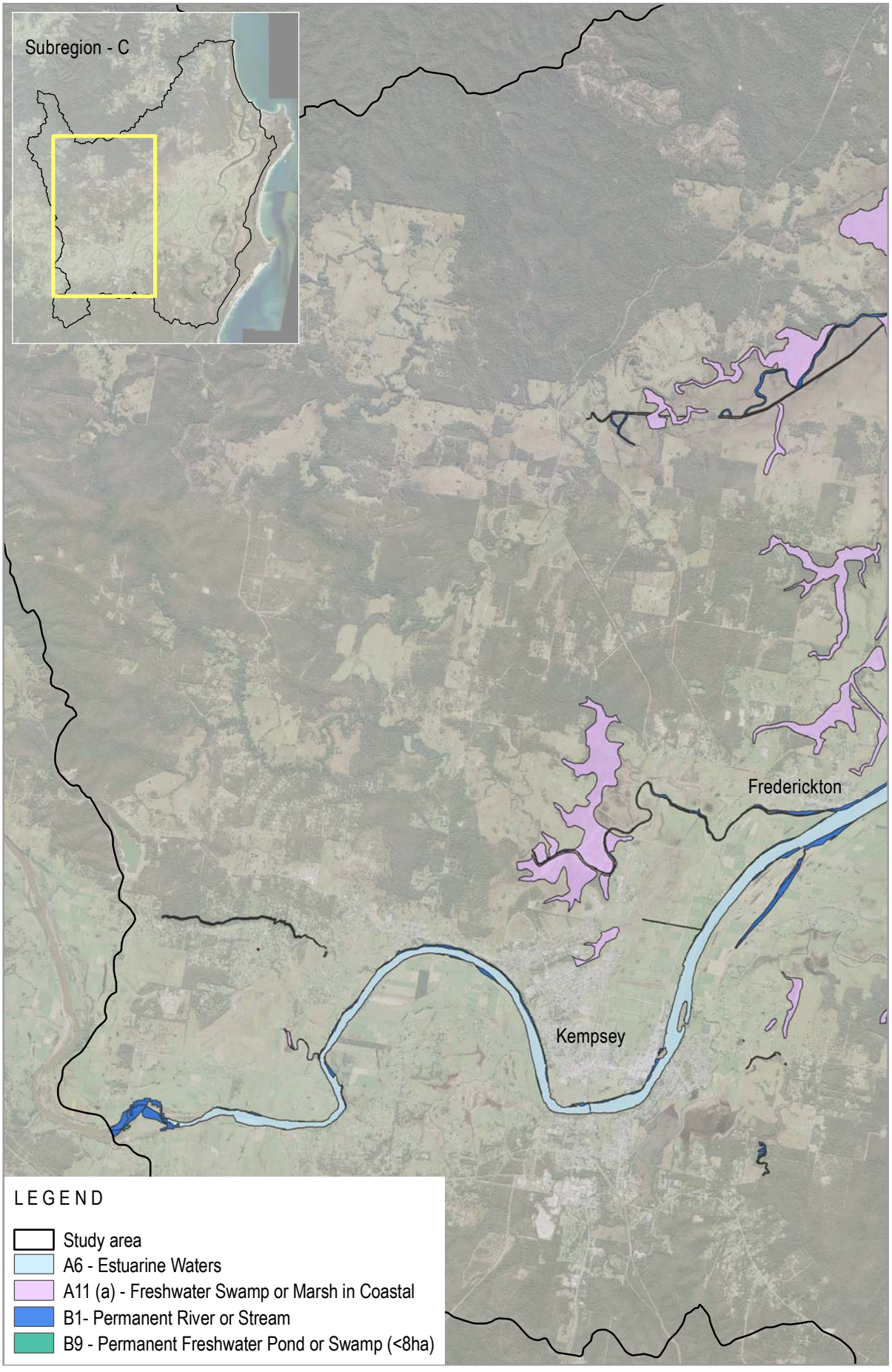
*Source of base data: Kempsey Shire Council and Wetland Care Australia*




North

0 2 km

# Distribution of Wetlands within the Study Area - Subregion C

According to Burns et al. (2006) the part of the Macleay River floodplain found within the study area contains approximately 73km2 of freshwater floodplain wetlands areas (not including Raffertys and Frogmore). This represents approximately 70% of the total wetland area inside the study boundaries, including estuarine waters and other marshlands. The Macleay floodplain holds approximately 15% of the coastal floodplain wetlands in NSW (Kingsford et al. 2003).

The maps produced by the North Coast Environment Council Inc (Parkhouse *et al*. 1999) were created by superimposing wetland vegetation maps over wetland soil maps. The source data were primarily existing aerial photographs and maps but approximately 60% of all vegetation units mapped were checked from the ground. They mapped 402 $km^2$ of wetland vegetation in the Kempsey Shire LGA. This figure is difficult to compare to the Wetland Care Australia mapping due to differences between the boundaries of the study area. Telfer (2005) noted that the usefulness of the mapping data is limited by problems with digital transfer into Geographic Information Systems.

Pressey (1989) mapped freshwater wetlands on the Macleay floodplain and described 432 individual units with an approximate total area of 128$km^2$. He also described the size distribution of floodplain wetlands on the Macleay noting that the three largest wetland areas account for 73% of the total area and that only 3% of individual wetlands mapped are greater than 1$km^2$ in size.

A series of maps of the historical extent of the Macleay floodplains has been produced using a mixture of information (M. Tulau *pers comm*. 2009). The resulting maps, though incomplete in some small areas may prove useful in understanding historical changes in habitat availability and the productivity of the estuary. To date, no GIS layer of these maps is available.

### 4.1.2 Major Wetland Areas on The Macleay

#### *4.1.2.1 The Swan Pool/Kinchela Swamp*

The Kinchela area is made up of two large contiguous swamp areas located either side of Kinchela Creek to the east of the Belmore River. They have been variously referred to as the Swan Pool, Kinchela Swamp and as east and west Kinchela Swamp. Here they will be referred to as East Kinchela Swamp and West Kinchela Swamp. Much of the swamp area around Kinchela lies at a level of around 0 m AHD. The Kinchela swamp area is, in turn, contiguous with the Belmore Swamp, meaning it is replenished by both Kinchela Creek and the Belmore River (Naylor and Tulau 1999).

The Kinchela Swamps are modified for drainage in a variety of ways and play an important part in the overall flood security of the Macleay Valley. Under flood conditions control gates on the left and right bank of Kinchela Creek allow backfilling of the two swamp areas. When flood waters in the Macleay River subside the swamps are drained by a number of floodgated drains and channels. The major drains are Schoolhouse, Hoffmans and Irwins drains. The drains shortcut the natural connection between the swamps and Kinchela Creek and continue to drain groundwater after surface waters have been removed. A structure known as 'The Lock' is positioned at the point where Kinchela Creek opens out into the east Kinchela Swamp in order to prevent unwanted saltwater intrusion during dry times. East Kinchela Swamp is also connected to Korogoro Creek via a floodgated drain that was cut through barrier dunes on its north eastern margin in 1968. This drain operates automatically once floodwaters in the swamp reach a certain level.

The Kinchela Lock is now owned and managed by the Parks and Wildlife Group (PWG) and will be subject to a management plan administered by the PWG. The PWG estate also owns the majority of the land incorporating the East Kinchela Swamp.

The entire west Kinchela Swamp is privately owned. Many of the landholders in this area have expressed an interest in managing the wetland for improved environmental outcomes (NCEC 1999). A number of

modifications to individual drain and floodgate structures were undertaken as Macleay Acid Sulfate Soil Local Action Group (MASSLAG) projects with funding from the Acid Sulfate Soils Program.

Issues associated with flood mitigation include the decomposition of non-water-tolerant pastures, subsequent effects on the quality of the discharged water and large fish kills in the swamp area as fish that were swept in during backfilling become stranded and die. The water quality of Kinchela Creek has suffered negative effects associated with drainage and the exposure of acid sulfate soils. Kinchela Creek has a low tidal prism relative to its catchment. The effect of this is that poor quality water released or drained from the swamps is slow to be flushed from the system and the negative impacts are prolonged (Tulau & Naylor 1999).

The Kinchela Swamp is listed in the Directory of Important Wetlands of Australia. Most of the area of east Kinchela Swamp is within the boundaries of SEPP 14 wetland 458 but west Kinchela Swamp is not. Areas of the Kinchela swamp, along with the Belmore Swamp were mapped as having the highest conservation value of wetlands on the Macleay (NCEC 1999). Only a relatively small area of this wetland complex falls within SEPP14 boundaries. A remediation program was undertaken for an area described as an acid sulfate soil hotspot in 2004.

#### *4.1.2.2 Clybucca/Collombatti Wetland*

The extensive Clybucca/Collombatti wetland complex is found in the northernmost area of the Macleay floodplain. It contains a number of large contiguous swamp areas centred on Collombatti Creek and draining through Clybucca Creek. It includes areas historically known as the Seven Oaks Swamp, Doughboy Swamp and Mayes Swamp. The wetlands once formed one of the largest backswamp areas in NSW. Some of the Clybucca wetlands are of very low elevation, particularly those towards the north, such as Mayes Swamp which is lower than 0m AHD in some areas. The elevation grades up towards the south with some areas around Bellimbopinni greater than 2 m above AHD. The Clybucca Swamps are now drained extensively, primarily by the Seven Oaks drainage system. Tidal exchange is controlled by the Clybucca Creek headworks which allow for drainage of the wetlands to 2.5 m below mean tidal level (Tulau & Naylor 1999). A large catchment of approximately 134 $km^2$ feeds the Clybucca/Collombatti wetland making it unique among the major wetland areas (Belmore swamp has a catchment area of about 1.8$km^2$. Prior to extensive drainage works, this factor would have inferred greater permanence of wetland pools in this area.

All of the major swamp areas around Clybucca are on privately owned land. Most of the areas drainage is managed by the Seven Oaks Private Drainage Board. The main part of the Clybucca wetlands, found to the west of the Pacific Highway is not protected by SEPP 14 legislation. Wetlands in this area include stands of swamp mahogany forest and they support a wide range of threatened fauna (NCEC 1999). A variety of programs have been put in place on individual properties, which includes shared infrastructure to manage the large acid sulfate scalds and improve the habitat value of the swamps around Clybucca. A database of these projects is currently being compiled (Birch and Andrighetto 2010).

Wetlands Care Australia (WCA), with support from the Northern Rivers Catchment Management Authority, is currently preparing a management plan for the Clybucca Floodplain Wetlands. The management plan will identify the key values of the Clybucca Floodplain Wetlands and will detail the major issues affecting the land, soil, water and biodiversity of the area. Priorities for management action across the floodplain will be identified and options for projects and funding listed. Priority actions might include managing drains more effectively through bank revegetation and weed control; protecting areas of bushland and riverbanks through stock fencing; managing wetlands and biodiversity while also providing freshwater pasture which may improve productivity and offer better seasonal grazing opportunities (Wetlands Care Australia, 2010).

#### *4.1.2.3 Belmore Swamp*

The Belmore Swamp is an extensive swamp area surrounding the upstream reaches of the Belmore River, west of and contiguous to the Kinchela Swamps. The Belmore Swamp has also been extensively

modified for drainage and flood mitigation purposes. Aside from the series of small drains that shortcut the natural connection of the wetland with the Belmore River there are two major drainage structures that connect the Belmore Swamp to Killick Creek and the Pacific Ocean respectively. There are also a number of floodgate type structures that control water movement. The Belmore River flood control structure allows flood waters to be stored in the swamp basin during flooding. This water then drains gradually back into the Belmore River as the flood recedes.

The Killick Creek floodgates are located on the drain between the swamp and Killick Creek approximately 1.5 km north of Crescent Head. The floodgates are designed to prevent saltwater penetration from Killick Creek, but also allow drainage of floodwaters from the swamp to the Pacific Ocean via Killick Creek. Issues associated with floodwater storage include the decomposition of non-water-tolerant pastures, subsequent effects on the quality of the discharged water and extensive kills of stranded fish that have been swept into the area. The tidal flushing of the Belmore River is relatively inefficient. The effect of this is that poor water quality conditions persist for up to three weeks after a flood event (Naylor and Tulau (1999).

Drainage of the Belmore Swamp has led to drastic changes in its ecology. There was formerly 1300ha of open water in the swamp that remained there for up to 6 months of the year (Tulau & Naylor 1999). Extensive areas of seasonally inundated rushes have now been replaced by less water tolerant species. The swamp was formerly managed by a number of drainage unions, though none of these is active today. The drains and floodgates are owned and operated by a mixture of Council and individual landholders.

Most of the Belmore Swamp is not protected under SEPP 14 legislation. Areas of the Belmore Swamp, along with the Kinchela Swamp were mapped as having the highest conservation value of wetlands on the Macleay (NCEC 1999). A variety of management efforts are planned or already operating on the Belmore wetlands. A database of these efforts is currently being prepared (Birch and Andrighetto 2010).

#### *4.1.2.4 Yarrahapinni Broadwater*

The Yarrahapinni Broadwater wetland complex is formed around the confluence of Borirgalla and Barraganyatti Creeks and Andersons Inlet. The area was long considered one of the most productive parts of the greater Macleay Estuary supporting healthy commercial fisheries and containing extensive mangrove (> 80ha), saltmarsh (> 300ha) and seagrass communities (NPWS 2009). The area also has significant Aboriginal cultural heritage values.

The Yarrahapinni wetlands are unique in the Macleay system, being a tidal/saltwater wetland nestled between dune systems as opposed to a freshwater backswamp on the floodplain such as the Kinchela, Clybucca or Belmore swamps.

The Yarrahapinni wetlands were among the last wetlands on the Macleay floodplain to be drained. In the early 1970s the 4 islands that once formed the entrance to the system were joined with a bund wall levee and floodgates were installed across the easternmost end of the levee. Drainage pathways were deepened and straightened. The works reduced the spread of permanently inundated land and largely removed the tidal influence but did not create any valuable agricultural land in the upstream area.

Currently the wetland is a degraded brackish swamp in the former broadwater area with areas dominated by *Phragmites australis*, *Casuarina glauca* or *Paspalum vaginatum* depending on elevation. Upstream areas are characterised by active acid sulfate soils, soil subsidence and the creation of monosulfidic black oozes. The valuable and productive estuarine habitats had been lost.

In April 2007 600ha of the complex was gazetted under the Yarrahapinni Wetlands National Park. A plan of management for the area is being prepared. PWG is now pursuing the full rehabilitation of the wetlands, with the end goal being to restore the wetlands to a natural state reminiscent of the site prior to the flood mitigation works in the 1970s. The full rehabilitation will be undertaken in a staged approach

allowing for adaptive site management whilst ensuring positive environmental outcomes for all stakeholders.

A restoration plan for the wetlands has been prepared, focussing on the hydrological and groundwater/aquifer interactions (WRL, 2009). This report now forms the basis of the Yarrahapinni Wetlands rehabilitation project.

Interim flushing of the wetlands has been undertaken since December 2007 with the installation of two tidal flushing gates on the floodgates. This enabled partial tidal exchange in the lower reaches of the wetlands and allowed some saltwater flushing and fish passage. From 2007 to 2009, NSW I&I (DPI, Fisheries) staff and Kevin Wilkinson (PhD student), undertook regular monitoring of the fish species in the lower broadwater area of the wetlands. Kevin has also continued to monitor the water quality and water levels in the wetlands since 2007. Changes are already evident with an increased number of estuarine indicator fish species being recorded in the lower reaches. In February 2010 one of the tidal gates was opened entirely. Early indications are that the salinity regime and water level have responded quickly to increased tidal flushing (K. Wilkinson *pers comm*.). NSW Fisheries (now Primary Industries - Industry & Investment NSW) has advised that Yarrahapinni has been gazetted as a 'Closed Fishing Zone' (NSW Department of Industry and Investment – Primary Industries, 2010).

Recent PWG works have included:

- a fauna survey of the wetlands with the data to be entered in Atlas of NSW Wildlife;
- a weed management plan is to be finalised mid 2010; and
- comprehensive vegetation mapping using ADS 40 photography is in progress.

#### *4.1.2.5 Other Major Wetland Areas*

There are a number of other significant wetlands on the Macleay floodplain. These include the areas known as the Frogmore Swamp, Raffertys Swamp, East Kempsey Swamp and Christmas Creek swamps. Management and restoration of East Kempsey Swamp is currently being investigated under the Gills Bridge Creek Rehabilitation Project run by Council. This is discussed further in **Section 13** in respect to water quality improvements.

Frogmore and Raffertys swamps are subject to the same drainage pressures as the other major swamp areas though 3 km of the original 3.8 km main drain on Raffertys Swamp has been replaced with a wide, shallow 'dish' drain (WMA Water 2009). In addition to this, a tidally operated floodgate has been installed at the outlet of Raffertys drain to improve water quality and aquatic habitat in the lower sections of the drain.

### 4.1.3 Macleay Floodplain Wetland Ecology

The ecology of the wetlands on the Macleay floodplain has been drastically altered as a result of physical changes and clearing for specific landuses. Despite this there are some areas that are regarded as being of high conservation value.

A comprehensive survey of freshwater wetlands on the Macleay found 118 wetland plant species. Of these, 73 were present in less than 5% of the wetlands surveyed. Four of the species were described as rare or of specific conservation significance. Twenty of the species recorded were introduced and their occurrence covered approximately 1.5% of the total wetland area at the time of survey. The most extensive of these were *Eichhornia crassipes* a declared noxious weed in all states of Australia, *Salvinia molesta* and *Echinocloa crus-galli*. Of the 432 individual wetlands, only 64 (<15%) had more than 10% of their margins lined with trees, as a result of clearing for grazing. On the other hand, the vast majority of wetlands (324 or 75%) had more than 90% of their margin lined with emergent vegetation (Pressey 1989). At the time of the survey, two species (*Juncus polanthemus* x *usiatus* and *Persicaria hydropiper*) covered

33% of the wetland area surveyed. In contrast, less that 11% of wetland area surveyed contained more than 15 species.

Of the 438 wetlands surveyed by Pressey (1989) 99% were grazed to some extent by cattle and 96% of the total wetland area was affected by drainage. In addition they found that only 2.5% of wetland area was open water, limiting the habitat value of the wetlands to aquatic animals and waterbirds. The work included ranking the wetlands for conservation though this information was not published with the report.

The vegetation in the Macleay floodplain wetlands was mapped in 1999 using a mixture of aerial photographic analysis and ground truthing exercises (NCEC). Descriptions of the vegetation in each swamp area are contained in **Table 4.1**. The subsequent report focussed on the occurrence of littoral rainforest communities, and the keystone species, swamp mahogany (*Eucalyptus robusta*).

A number of bird species listed under the *TSC Act 1995* or protected under international treaty occupy the Macleay floodplain wetlands (see NCEC 1999, Godrick 1970).

**Table 4.1 Vegetation and Management Issues by Floodplain Area**

| *Floodplain Area* | *Dominant Vegetation Communities* | *Management Issues* |
|---|---|---|
| Clybucca/Collombatti | Majority sedgeland. Some swamp schlerophyll forest, grassland and *Casuarina* forest. Small area of *Melaleuca* and swamp mahogany forest. | ▪ overdrainage;<br>▪ acid sulfate soils;<br>▪ poor export water quality after flooding and associated fish/oyster kills;<br>▪ uncontrolled encroachment of saline waters above the headworks; and<br>▪ limited areas of open water. |
| Belmore | Majority sedgeland. Some fringing *Casuarina* forest and *Melaleuca* and swamp mahogany forest. Small area of wet meadow. | ▪ poor export water quality after flood mitigation operation;<br>▪ major fish kills in Belmore River; and<br>▪ saline intrusion through Killick Ck headworks. |
| Kinchela | Majority sedgeland. Some fringing swamp schlerophyll forest | ▪ overdrainage;<br>▪ vandalism to 'The Lock';<br>▪ poor export water quality;<br>▪ encroachment of stock animals onto PWG managed wetland;<br>▪ *Salvinia molesta* infestation in drains and open water; and<br>▪ landholder resistance to wetter management of East Kinchela wetland. |

| *Floodplain Area* | *Dominant Vegetation Communities* | *Management Issues* |
|---|---|---|
| Yarrahapinni | Majority *Casuarina* forest, *Melaleuca* forest and saltmarsh. | ▪ landholder resistance to rehabilitation plans; and<br>▪ lack of funding to complete adequate monitoring of rehabilitation. |
| Frogmore | Mostly Grassland. Small area of swamp schlerophyll forest and *Casuarina* forest | ▪ overdrainage; and<br>▪ ASS. |
| Raffertys | Majority sedgeland | ▪ lack of monitoring of changes since modification to main drain. |
| East Kempsey | Mostly grassland and sedgeland | |

### 4.1.4 Grazing on Macleay River Floodplain Wetlands

The drainage of wetlands on the Macleay floodplain began in the early 20th century as a way of accessing land that was thought to be highly productive for the purposes of agriculture. To this day, most of the areas that were historically floodplain wetlands are now grazed to some extent and some cropping and horticulture occurs.

The success of drainage and flood mitigation works in creating viable agricultural land has been mixed. In some cases land claimed by drainage and flood mitigation has proved to be some of the most valuable in the area and in other cases the works have resulted in severe acid scalds and barren, unproductive land.

The impact of grazing on wetland sites is difficult to generalise as it depends on a variety of factors including the density of stock, the specific nature of the site, and stock and pasture management techniques. Retention of land for grazing is the primary obstruction to the management of floodplain wetlands for environmental outcomes.

### 4.1.5 Wetland Protection, Conservation and Rehabilitation Measures

A number of protection and conservation measures operate on or are relevant to the management of Macleay River floodplain wetlands. Freshwater wetlands on coastal floodplains have been identified as an Endangered Ecological Community and are listed as such under the *Threatened Species Conservation Act 1995* (NSW Scientific Committee 2005). Of the approximately 73 $km^2$ of total wetlands within the study area, approximately 44 $km^2$ are contained within the boundaries of SEPP 14 areas. Subsequently, a number of the Macleay floodplain wetlands do not fall under the protection of SEPP14 legislation. This is most likely a result of exclusion criteria, by which, wetlands were excluded from consideration if they displayed all of the following five characteristics:

- presence of functional drains;
- presence of fence lines;
- paddock differentiation;
- signs of reclamation, clearing or contraction of a previously permanently inundated area; and
- lack of a natural boundary with bushland estuary or large waterway.

A variety of rehabilitation/management projects are being undertaken on floodplain wetlands around the Macleay. A summary of these works is provided in **Table 4.2**.

**Table 4.2 Summary of works undertaken on the Macleay floodplain wetlands by area**

| *Backswamp Area* | *Location* | *Works Description* | *Notes* |
|---|---|---|---|
| Belmore | Scotts Drain | Lifting device and mini-sluicegate installed on Scotts Drain floodgates to allow active management. Tidal waters can now be utilised to remediate the scald. Further works are in the planning stages for this area. | Photographs show lush green growth of rushes has established over the previously scalded area |
| | Eakins Drain | New culvert installed including a flap gate. Drop boards and lifting device are to be installed. | |
| | Tracey's Culvert | Dropboards for elevated drain inverts | |
| | Triple S Ranch | Lifting device and dropboards installed | |
| | Fischers #2 Drain | Culvert with dropboards installed. | Large area of wetland reinstated. |
| | McCuddins Drain | Culverts with floodgates and dropboards installed. Drain clearing undertaken so that inundation can occur with tidal movements if so desired. | Photographs show that the previous scald has now been covered with green growth. |
| | Sillitoe's Drain | Culverts with floodgates installed in existing drain | |
| | Thurgood Drain | Culvert with floodgate installed in existing drain for wet pasture management | |
| | Ptolemys Farm | Sluice gate and lifting gear installed on floodgate. Drains cleared to allow inundation of ASS scald. Cattle exclusion fencing also installed. | Scald largely covered with lush growth. |
| Kinchela | Irwins Drain | Modified headworks for water detention | |
| | Council Drain | Dropboard structure replaced with new culvert and sluice gate | |
| | Bradleys Drain | Lifting structure installed on one of the five cells of the floodgates. | |
| | Kinchela No2. | New culvert with floodgates installed to prevent tidal ingress. | |
| | The Lock | Fish friendly, automatic (tidally operated) floodgate installed on one of three cells. | |

| *Backswamp Area* | *Location* | *Works Description* | *Notes* |
|---|---|---|---|
| | Rogers' Farm | Active water management targeting improved productivity, ASS remediation and improved export WQ. | Project site for Coastal Floodplain and Acid Sulfate Soil Management Project. |
| | Gladstone Union Drain | Low level weir structure planned for the drain. | Project has not commenced due to landholder resistance |
| | School House Drain | Cattle exclusion fencing installed to assist in ASS scald remediation. | |
| | Wilsons Drain | Sluice gate and lifting devices installed for active water management. | |
| Clybucca/Collombatti | East Drain | Low level weir installed | |
| | West Drain #1 | Low level weir installed | |
| | West Drain #2 | Low level weir installed | |
| | Various | Revegetation of ASS Scalds to reduce impacts. | |
| | Yerbury Farm | Variety of structures and methods used for wetter pasture management. | Large areas of ASS scalds now productive pasture areas. |
| Raffertys | Raffertys Drain | Drains converted to shallow dish type and tidally operated floodgate installed. | Completed in 2005. Photographs show positive results. |
| | Prattens Farm | Wet pasture management. Large culverts installed in existing drains to support dropboards. | |
| | Marriots Drain | Lifting device fitted to floodgates for active water management. | |
| Frogmore | Union Floodgates and various other localities | One of nine cells on the union floodgates to remain open in dry times to improve water quality upstream. Two tidal floodgates installed. Improved lifting devices installed. Twenty small, in-system water control structures installed to avoid undesirable pasture inundation. | WQ monitoring results indicate significant improvements above floodgates when open. |
| | Darkwater Drain | Modification of existing levee to allow for increased tidal flows. | |
| Other | Clancys Drain | Modifications to the weir on West drain to provide dropboards to allow active management of water levels. | |

| Backswamp Area | Location | Works Description | Notes |
|---|---|---|---|
| | Clancys Drain | Culverts with floodgates and dropboards installed in drain. | |
| | Spencers Inlet | Auto (tidally operated) floodgates installed for improved water quality upstream of drain. | |

### 4.1.6 Prioritisation of wetland areas for future conservation

The wetland areas on the Macleay river floodplain have been prioritised for conservation in three separate studies (Pressey 1987, Parkhouse *et al*. 1999 and Burns et al 2006).

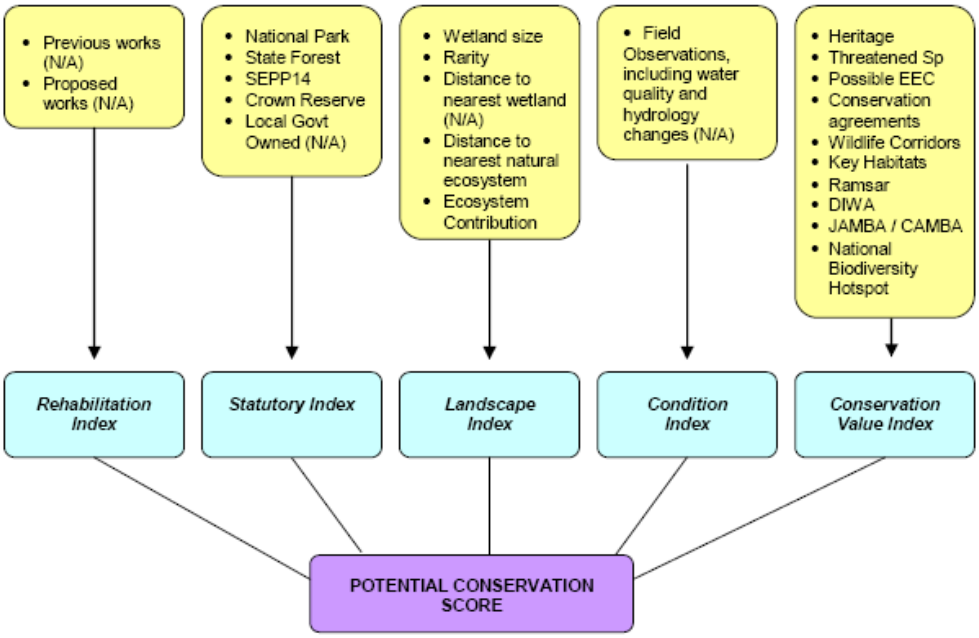



**Illustration 4.4 Wetland conservation prioritisation method used by WCA.**

Source: Burns et al. (2006)
Note: N/A indicates that no data were available at the time of publication.

WCA used the system depicted in **Illustration 4.4** to prioritise wetland units for conservation. They developed a list of attributes that were considered relevant to the conservation status of wetlands and scored individual wetland units for the presence absence or quality of the attributes. The attributes scores were then used to develop for each wetland an index unit relating to specific attributes. These were then used to generate a potential conservation score for each wetland unit. The specific method used by WCA utilised a data accuracy weighting and significance weight for the each of the attributes and again for each of the indices considered. For the purposes of this study, the potential conservation scores were used to develop conservation rankings as detailed in **Table 4.3**.

**Table 4.3 Conservation rankings using WCA conservation priority scores**

| *Conservation Score* | *Conservation Ranking* |
|---|---|
| 4-9 | Very Low |
| 10-14 | Low |
| 15-19 | Medium Low |
| 20-25 | Medium |
| 26-31 | Medium High |
| 32-39 | High |
| 40-46 | Very High |

NCEC used a spatial overlay technique to evaluate wetland areas for their conservation value. The factors considered were wildlife values, size and degree of drought refuge provided by the wetland area. The degree of wetland disturbance was not included in the NCEC scoring. Four conservation values were generated and mapped. For the present study these were labelled very high, high, low and very low.

Pressey (1987) identified 32 wetlands of outstanding natural value on the Macleay floodplain based upon the presence of threatened plant species or value as a drought refuge. Clybucca/Collombatti, Belmore, Kinchela and East Kempsey Swamps all fell into this category. Kinchela swamp and Frogmore swamp were mapped as one contiguous unit. Pressey (1987) noted that the conservation of these wetlands would not be adequate and ranked all of the 432 wetland units he identified on the Macleay using the following categories:

- Representation, rareness, interspersion and diversity of vegetation/habitats;
- Vegetation cover; and
- Condition of vegetation at wetland margins.

These attributes were combined in a simple way to give the wetlands a ranking value for reservation (out of 25) or for protective zoning (out of 30). The two rankings only differed by the inclusion of the condition of wetland margins in the latter ranking. For the purposes of estuary management on the Macleay, only the major wetland areas, described above, are considered, as their impact on the estuary is the most significant due to their area, stability and the focus of drainage amongst them. It is worth noting though, that the Pressey (1987) document provides a valuable resource for conservation on the floodplain in general. In order to apply the results from Pressey to the present study, the rankings for protective zoning were used and placed into categories as per **Table 4.4**.

**Table 4.4 Conservation rankings using Pressey (1989) conservation priority scores.**

| *Conservation Score* | *Conservation Ranking* |
|---|---|
| 1-6 | Very Low |
| 7-12 | Low |
| 13-18 | Medium |
| 19-24 | High |
| 25-30 | Very High |

The results of the above three studies were combined to form an overall conservation ranking for the major Macleay floodplain wetland areas. The results are presented in **Table 4.5**. The table shows that Belmore wetland area has the highest priority for conservation followed by Yarrahapinni and Kinchela. This priority ranking is further utilised in **Section 6.4** to assist in prioritising areas for drainage improvement works to improve wetland health and overall estuary health.

**Table 4.5 Floodplain wetland conservation priorities by area**

| *Wetland Area* | *WCA* | *NCEC* | *Pressey* | *Overall Ranking* |
|---|---|---|---|---|
| Clybucca/Collombatti | Medium High | Medium High | Very High | 4 |
| Belmore | Very High | High | Very High | 1 |
| Kinchela | High | High | Very High | 3 |
| Raffertys | Not Mapped | Medium Low | Medium | 6 |
| Frogmore | Not Mapped | Medium Low | Very high | 5 |
| East Kempsey | Medium Low/Low | Low | Very High | 7 |
| Yarrahapinni | Very High | Medium High | Not Assessed | 2 |

## 4.2 Issues

### 4.2.1 Acid Sulfate Soils

Acid sulfate soils (ASS) are common to all of the major wetland areas. Some areas have been rehabilitated successfully. Runoff from ASS contributes to poor water quality in the estuary and can cause fish kills.

Whilst ASS in the catchment area are all derived from iron rich estuarine sediments in low lying lands, the export of acid water depends on a number of site specific factors. The most relevant of these are, drain depth, soil hydraulic conductivity and their interaction with local climatic features. The methods appropriate for the management of acid sulfate soils are also highly site specific, depending on the position relative to estuarine waters, site elevation, soils and other physical limitations. Acid sulfate soils are considered in more detail in **Section 5** of this report.

### 4.2.2 Monosulfidic Black Ooze

Monosulfidic black ooze (MBO) is created rotting organic matter that is enriched with iron monosulfides. When disturbed and transported during flow events, MBOs have the capacity to rapidly deoxygenate water and severely disrupt the ecology of waterways. MBOs form under conditions where there is low flow, an abundance of vegetation and high concentrations of iron and sulphur from acid sulfate soil drainage. Floodgated drainage canals from low lying backswamps over estuarine sediments provide excellent conditions for their formation.

Catastrophic fish kills associated with the disturbance and transport of MBOs have been described in great detail from the Richmond River and Clarence River (Eyre *et al* 2001, Johnstone *et al* 2003) but not yet from the Macleay. Despite the lack of hard evidence, the same conditions that have led to the formation and activation of MBOs on the Clarence and Richmond exist on the Macleay. The distribution of MBOs in the estuary is currently unknown and likely to be variable depending upon conditions. The drains above the Clybucca Creek floodgates are widely considered to be the source of black ooze that anecdotal evidence suggests affects the Macleay River oyster industry and causes fish kills.

### 4.2.3 Degraded Infrastructure

Much of the infrastructure (drains and floodgates) associated with the drainage of the Macleay floodplain wetlands is in a degraded state. In some cases it is unclear who is responsible for the replacement or maintenance of floodgate infrastructure. In addition to this, the costs of repairing or replacing infrastructure may be very high. At this stage, in most cases it is unclear if the costs are justified by the flood mitigation and drainage functions provided and the associated effects upon ecosystem values.

Floodgate and drain infrastructure is explored in greater detail in **Section 6** of this report.

### 4.2.4 Over Drainage

A survey of the Macleay floodplain wetlands indicated that 96% of the total wetland area is affected by drainage.

The over-drainage of wetlands is not just associated with the production of ASS and export of acidic materials into the estuary but also reduces the ecosystem values of the wetlands and the agricultural productivity of the land. There is increasing evidence that 'wetter' wetlands may have significant benefits for landholders and the environment.

### 4.2.5 Reduction of Ecosystem Values

As a direct result of land clearing, drainage and flood mitigation, the ecosystem values of the Macleay floodplain wetlands have been reduced. These values are difficult to quantify, due to the inherent difficulties of placing a value on primary production, habitat and biodiversity. This difficulty is compounded by the fact that little or no information about the pre-drainage state of the wetlands exists. Certainly the biodiversity associated with healthy floodplain wetlands has been reduced. Pressey (1989) described two species (*Juncus polanthemus* x *usiatus* and *Persicaria hydropiper*) covering 33% of the wetland area surveyed. In contrast, less that 11% of wetland area surveyed contained more than 15 species, though 118 species were described in total. He described wetland drainage as a major cause of this factor. Less than 3% of the area of wetlands on the Macleay is open water (Pressey 1989). This limits the utility of wetland areas to water birds and may largely explain the reduction in the extent of some large and migratory species recorded in avifauna surveys (NCEC 1999).

In the case of the Yarrahapinni wetlands an attempt has been made to place a value on ecosystem services. The North Coast Environment Council (NCEC 1999) estimated the loss of fisheries productivity associated with the loss of mangrove habitat in the Yarrahapinni system to be $1.7 million annually. On the other hand, the drainage and flood mitigation changes to the Yarrahapinni wetlands have provided no measurable benefits to agricultural productivity or flood mitigation.

Pressey (1989) surveyed floodplain wetlands on the Macleay and found that 99% of them are grazed to some extent and that agriculture is the dominant or sole use in 93% of their catchments.

### 4.2.6 Reduced Connectivity Between Floodplain Wetlands and Estuarine Waters

All of the major Macleay River floodplain wetland areas have reduced natural connectivity to the waters of the estuary. The floodgates and other modifications associated with flood mitigation and drainage have reduced the brackish and freshwater habitat available to catadromous species (migrating from fresh water to marine waters to spawn) and anadromous species (migrating from marine waters to fresh water to spawn) that utilise them. These species include eels, prawns, bass, mullet and a variety of smaller species important to the structure of the food web in the estuary.

In addition to this the modifications to the floodplain wetlands have changed the overall productivity of the system. The nature of this change is yet to be demonstrated in a quantitative fashion.

### 4.2.7 Limited Areas of Open Water

The extent of open water on the Macleay floodplain has been greatly reduced as a result of the drainage of wetland areas and, in some cases, the spread of aquatic weeds. This results in a reduction in the diversity and abundance of birdlife and may also have had a negative impact on aquatic fauna.

### 4.2.8 Aquatic Weeds

Outbreaks of aquatic weeds, most notably *Salvinia molesta* are known to occur in the East Kinchela swamp and have been observed on a number of drains leading to the Macleay River, Belmore River and Kinchela Swamp. It is possible that outbreaks of *Egeria densa* may also occur throughout wetland areas. These weeds can reduce the ecosystem values of open water for birds and fish, provide a source of organic material for the production of MBOs, which result in severe diurnal fluctuations of dissolved oxygen and completely deoxygenate the water column when they breakdown *en masse*.

### 4.2.9 Inadequate Conservation of Freshwater Floodplain Wetland Areas

Four primary conservation measures are currently operating on floodplain wetlands in the coastal Macleay River catchment. The first of these is the State Environmental Planning Policy (SEPP) 14. This policy sets allowable activities in designated wetland areas. The second measure applies to the rehabilitation of the Yarrahapinni Wetland area, for which a plan of management detailing the required measures for the reestablishment of the estuarine wetland habitat in the Broadwater and upstream. The third measure is the purchase by the Parks and Wildlife Group of major areas of the Swan Pool/East Kinchela Wetland and subsequent management of the area for environmental values. The fourth is a loose collection of land management changes being undertaken by landholders in conjunction with Kempsey Shire Council and the Northern Rivers Catchment Management Authority. Other potential conservation measures include protection zoning under Council's LEP and BioBanking. These two measures are discussed further in **Section 10** in respect to habitat protection.

Despite these efforts, there is still a lack of conservation measures protecting freshwater wetlands on the lower Macleay system. The Yarrahapinni wetland is unique on the Macleay floodplain, being (originally) an estuarine system located between old dunes. It cannot be seen as representative of the floodplain wetlands generally as it represents a different class of ecosystem. SEPP 14 covers less than half of the wetlands (by area) in the study area and it does not stipulate that wetlands need to be managed for environmental values. Management of the Swan Pool for environmental values is hindered by existing drains, the nature of the Korogoro Cut, piecemeal ownership of the land and landholder resistance.

A desirable outcome of this plan would be to have at least one of the major wetlands on the Macleay being managed strictly for environmental outcomes. The basic management aims would be for improved water quality (which would be desirable for all wetland areas), improved wetland productivity, improved habitat value for aquatic organisms and birds and improved biological connectivity between the wetland and the estuary.

### 4.2.10 Lack of a Strategic Approach to Management

A large number of individual programs have occurred across the wetland areas of the Macleay floodplain. Without diminishing the importance of these works it is noted that a strategic plan may assist the ongoing management of Macleay floodplain wetlands.

### 4.2.11 Lack of adequate monitoring of rehabilitation strategies

It is important that rehabilitation strategies are monitored to adequately gauge their success, assist with the planning of future rehabilitation techniques and to improve the understanding of how ecosystems respond to changes over time. An audit of current active floodgate management practices would be useful in identifying how well the various floodgate management plans (e.g. Clancy's Drain, Marriot's Drain) are proceeding and whether changes to these arrangements are desirable.

### 4.2.12 Intensification of drainage around Frogmore

In the Frogmore area, drainage improvement works have focussed on creating better water quality and fish habitat in the drains above the Union floodgates by active management of one of the nine cells in the floodgates (see **Table 4.2**). In order to do this smaller floodgates have been installed on some of the secondary drains. Many of the installed in-system structures were on dry ground with the intent to restrict tidal movement within the Frogmore and Darkwater Drains. Some landholders lift the in-system structures to deliver water onto their properties. Preferable modifications to the secondary drainage network will result in improved fish passage and groundwater retention. Ideally this will be achieved through active management, automatically operating gate structures, the installation of permanent sills or dropboards and reshaping of drains.

## 4.3 Management Objectives

***Management Objective 4/1*** Preparation of a strategic plan for the future management of wetland areas;

***Management Objective 4/2*** Improved export water quality from floodplain wetland areas;

***Management Objective 4/3*** Adequate conservation of representative areas of floodplain wetlands and the management of conserved areas for ecological outcomes. This management objective is also addressed by the strategies in **Section 10 – Habitat Protection**;

***Management Objective 4/4*** Improve the understanding of the biological connection between the floodplain wetlands and the estuary and how it can be managed;

***Management Objective 4/5*** Control of *Salvinia molesta* on wetlands and in drains;

***Management Objective 4/6*** Improved water retention.

## 4.4 Management Strategies

Management options for the Macleay wetland systems are provided below in tabular form.

**Belmore Area**

### 4.4.1 Continue to encourage wetter pasture management in the Belmore Swamp.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Stage an information day for local landholders to visit sites of successful wet pasture management on the Belmore backswamp. | 4/2<br>4/6 | KSC, NRCMA |
| Deliver educational material to landholders outlining the benefits of wet pasture management and opportunities for funding assistance etc. | 4/2<br>4/6 | KSC, NRCMA |
| Provide a structured framework to assist landholders interested in changing to wetter pasture management | 4/2<br>4/6 | KSC, NRCMA |

### 4.4.2 Investigate further changes to drainage infrastructure in the Belmore area that could increase water retention and reduce groundwater drawdown.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Make an assessment of works undertaken to date on drains in the Belmore backswamp area. Assess works based on cost, effectiveness, landholder satisfaction, effect upon environmental values and productivity etc. | 4/1<br>4/2<br>4/6 | KSC, NRCMA |
| Compile a list of drainage infrastructure that has not been the focus of any works to date. Include information such as infrastructure status, landholder willingness. | 4/1<br>4/2<br>4/6 | KSC, NRCMA |
| Prioritise drains and infrastructure based on the above information. | 4/1<br>4/2<br>4/6 | KSC, NRCMA |
| Prioritise drainage management works that result in the permanent retention of acceptable groundwater levels, improved fish passage and upstream habitat values or both. | 4/1<br>4/6 | |
| Outline available and suitable methods for improvements to the present situation. | 4/2<br>4/6 | KSC, NRCMA |
| Undertake works where appropriate. | 4/2<br>4/6 | KSC, NRCMA |

**Kinchela Area**

**4.4.3 Continue to improve the management of east Kinchela wetland for ecological values**

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Parks and Wildlife Group estate to continue to acquire east Kinchela wetland areas to an elevation of 0.5m AHD. | 4/3 | DECCW |
| Fence the boundaries of the Hat Head National Park on the western boundary of east Kinchela wetland to exclude cattle from PWG managed wetland areas. | 4/3 | DECCW |
| Reinstate the natural hydrological function of Kinchela Creek as much as possible, to increase the amount of open water habitat on the east Kinchela wetland. | 4/2<br>4/3<br>4/6 | DECCW |
| Reshape the existing drains or modify the drainage infrastructure on east Kinchela wetland to reduce the drainage of acidic groundwater, raise the water table and promote water retention. | 4/2<br>4/3<br>4/6 | DECCW, KSC, Landholders |
| Reshape the drain on the Korogoro Cut to reduce the drainage of acid groundwaters, raise the water table and reduce impacts on Korogoro Creek. | 4/2<br>4/3<br>4/6 | DECCW, KSC |

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Incorporate the management of east Kinchela wetland into the revised Hat Head National Park Plan of Management. | 4/1 | DECCW |
| Continue to control salvinia through monitoring and reapplication, where necessary, of ciological control methods. | 4/5 | DECCW |

#### 4.4.4 Investigate further changes to drainage infrastructure in the Kinchela area that could increase water retention and reduce groundwater drawdown.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Make an assessment of works undertaken to date on drains in the Kinchela backswamp area. Assess works based on cost, effectiveness, landholder satisfaction, effect upon environmental values and productivity etc. | 4/2<br>4/6 | KSC, NRCMA |
| Compile a list of drainage infrastructure that has not been the focus of any works to date. Include information such as infrastructure status, landholder willingness. | 4/2<br>4/6 | KSC, NRCMA |
| Prioritise drains and infrastructure based on the above information. | 4/2<br>4/6 | KSC, NRCMA |
| Prioritise drainage management works that result in the permanent retention of acceptable groundwater levels, improved fish passage and upstream habitat values or both. | 4/1<br>4/6 | |
| Outline available and suitable methods for improvements to the present situation. | 4/2<br>4/6 | KSC, NRCMA |
| Undertake works where appropriate. | 4/2<br>4/6 | KSC, NRCMA |

#### 4.4.5 Continue to encourage wetter pasture management in the west Kinchela Swamp.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Stage an information day for local landholders to visit sites of successful wet pasture management on the Belmore backswamp. | 4/2<br>4/6 | KSC, NRCMA |
| Deliver educational material to landholders outlining the benefits of wet pasture management and opportunities for funding assistance etc. | 4/2<br>4/6 | KSC, NRCMA |
| Provide a structured framework to assist landholders interested in changing to wetter pasture management | 4/2<br>4/6 | KSC, NRCMA |

#### 4.4.6 Reinitiate plans for improved management of the Gladstone drain.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Investigate reasons for previous landholder resistance. | 4/1<br>4/2<br>4/6 | KSC, NRCMA |
| Scope alternative methods for improving drain function, wetland values and water quality whilst meeting landholder needs. | 4/1<br>4/2<br>4/6 | KSC, NRCMA |
| Plan and implement works. | 4/2<br>4/6 | KSC, NRCMA |

**Yarrahapinni**

#### 4.4.7 Complete the rehabilitation of the Yarrahapinni Wetlands from a degraded, closed brackish system to a healthy estuarine system

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Undertake the steps outlined in the Yarrahapinni Wetlands National Park Restoration Plan (Glamore & Timms 2009). These include developing trigger levels for contingency actions, design of monitoring programs, design and construction of upstream levees and design of floodgate modifications. | 4/1<br>4/2<br>4/3 | DECCW |
| Incorporate the steps required for rehabilitation into the Yarrahapinni Wetlands National Park Plan Management | 4/1<br>4/3 | DECCW |
| Design and implement a long term ecological monitoring program to analyse changes in on-site ecology. A focus of this program should be changes in key estuarine habitat. The monitoring should also provide useful information about the adaptive behaviour of these habitats under future sea level rise scenarios. | | DECCW, CMA, I&I |

**Clybucca/Collombatti Area**

**4.4.8 Investigate changes to the drainage infrastructure in the Clybucca/Collombatti area with the aim of improved export water quality**

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Consult with landholders, drainage union members, local and state authorities and major estuary user groups including commercial and recreational fishers, oyster growers and tourism operators to gather information about the requirements for drainage and export water quality for the Clybucca system. Utilise outcomes of Clybucca Floodplain Wetlands project currently being undertaken by Wetlands Care Australia (refer to **Section 4.1.2.2**). | 4/1<br>4/2 | KSC, NRCMA, I&I |
| Consult with the above groups and specialists to generate a list of possible changes that could be made to the Clybucca drainage system to meet the demands of users and stakeholders. Utilise outcomes of Clybucca Floodplain Wetlands project currently being undertaken by Wetlands Care Australia (refer to **Section 4.1.2.2**). | 4/1<br>4/2 | KSC, NRCMA, I&I |
| Rank all possible changes based upon their ability to meet expectations, associated costs and acceptability to landholders and the Seven Oaks Private Drainage Board. Utilise outcomes of Clybucca Floodplain Wetlands project currently being undertaken by Wetlands Care Australia (refer to **Section 4.1.2.2**). | 4/1<br>4/2 | KSC, NRCMA, I&I |
| Prioritise drainage management works that result in the permanent retention of acceptable groundwater levels, improved fish passage and upstream habitat values or both. Utilise outcomes of Clybucca Floodplain Wetlands project currently being undertaken by Wetlands Care Australia (refer to **Section 4.1.2.2**). | 4/1<br>4/6 | |
| Generate a plan for the future management of the Clybucca/Collombatti drainage network. Utilise outcomes of Clybucca Floodplain Wetlands project currently being undertaken by Wetlands Care Australia (refer to **Section 4.1.2.2**). | 4.31<br>4/2 | KSC, NRCMA, I&I |

**4.4.9 Continue to encourage the uptake of wetter pasture management techniques in the Clybucca/Collombatti area.**

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Stage an information day for local landholders to visit sites of successful wet pasture management on the Clybucca/Collombatti backswamp. | 4/2<br>4/6 | KSC, NRCMA |
| Deliver educational material to landholders outlining the benefits of wet pasture management and opportunities for funding assistance etc. | 4/2<br>4/6 | KSC, NRCMA |

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Provide a structured framework to assist landholders interested in changing to wetter pasture management. | 4/2<br>4/6 | KSC, NRCMA |

**Other Wetland Areas**

**4.4.10 Investigate the effects of changes to drains in the Raffertys area.**

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Compile all monitoring information gathered from Raffertys drain since the changes implemented in 2005 | 4/1 | KSC, NRCMA |
| Describe gaps in the information that limit the understanding of changes to the ecology and water quality upstream of the floodgates on Raffertys Drain | 4/1 | KSC, NRCMA |
| Undertake monitoring activities where necessary to better understand what changes have come about as a result of management activities. | 4/1 | KSC, NRCMA |

**4.4.11 Update Wetland Care Australia floodplain wetland maps to include Frogmore and Raffertys wetland areas.**

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Revisit existing geospatial information to develop boundaries for the Raffertys and Frogmore wetlands and include them in any subsequent release of the mapping. | 4/1 | NRCMA, WCA |

# 5

# Acid Sulfate Soils

Acid sulfate soils (ASS) are a naturally occurring soil type that contains significant concentrations of iron sulfides, principally pyrite. Un-oxidised pyritic soils are referred to as potential ASS (PASS). When the soils are exposed, oxidation of sulfides results in the generation of sulphuric acid and acid leachates. The soils are then referred to as actual ASS (AASS).

ASS materials in subsurface sediments do not pose a problem if left undisturbed. However, when exposed to air by either excavation or lowering of the watertable, the ASS materials oxidise and in the presence of water will form sulphuric acid. This can occur through natural processes such as extended dry periods without rainfall resulting in a lowering of the watertable and formation of acid pools, which are later released during flooding events.

ASS can cause significant damage to the environment, human health and economics, including:

- inducing soil toxicities such as aluminium, iron and manganese;
- inducing soil deficiencies in phosphorous, potassium and calcium;
- degradation of water quality through severe acidification, deoxygenation and contamination;
- loss or change in habitat in waterways and on land;
- fish disease, fish kills and decline;
- corrosion of infrastructure such as roads, bridges, pipes, and foundations; and
- diminished agricultural productivity and food production.

## 5.1 Current Status

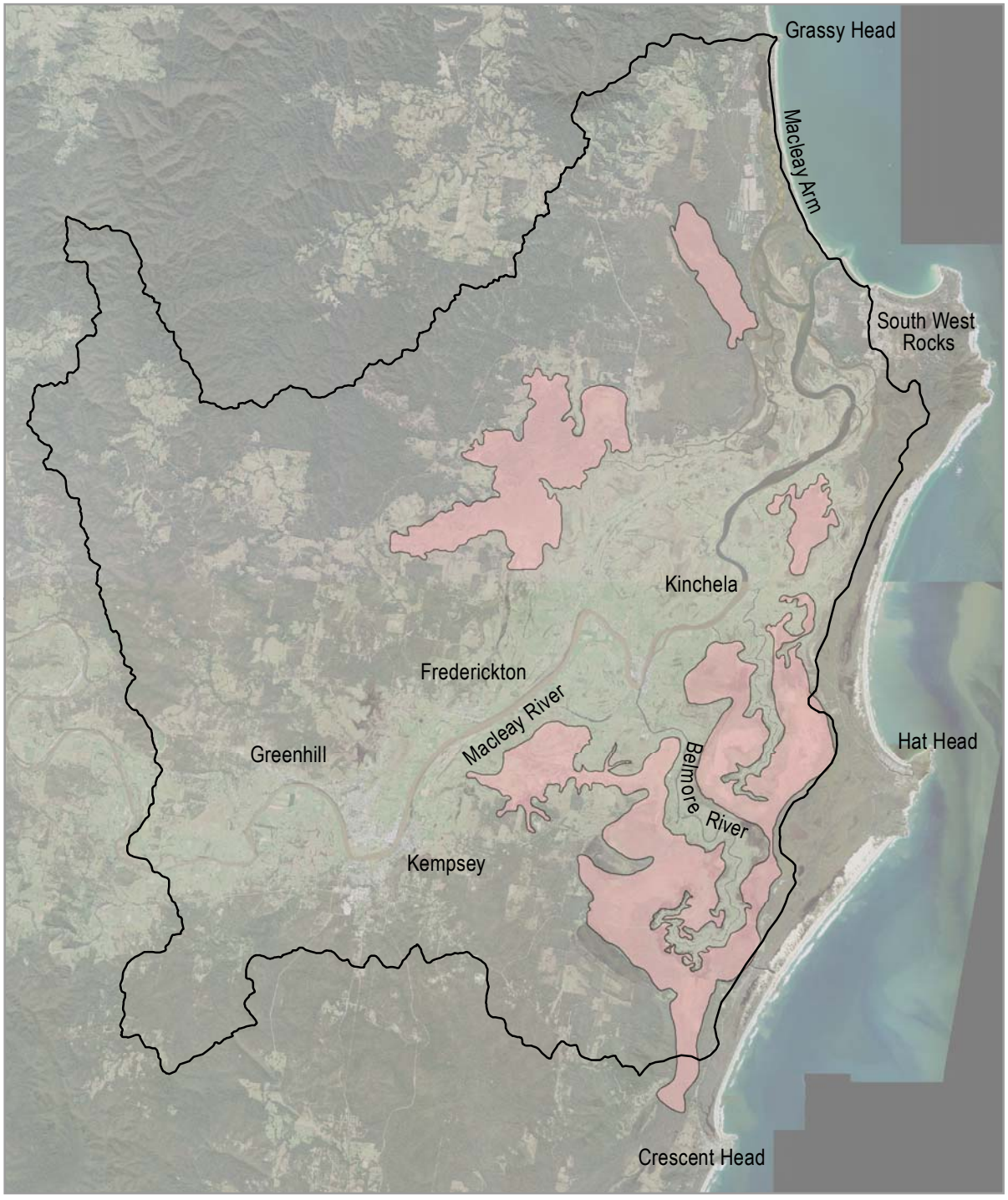
The Macleay floodplain is underlain by extensive estuarine deposits with large areas (estimated at 31,000 ha) of high risk ASS that is either at or near the surface (Naylor and Tulau, 1999). Flood mitigation and wetland drainage has extensively modified the Macleay estuary. This was done primarily for drainage of agricultural land and flood mitigation. The drainage works, dating between the 1920s to the mid 1970s, including floodgates, levees and artificial drainage channels lowered the water table, excluded saline water and drastically altered the ecology and water balance of the wetlands. This has facilitated oxidation of pyritic soils and formation of AASS which in areas has led to severe soil acidification, poor water quality, reduction in agricultural capability and productivity, and loss of estuarine habitat.

Approximately 8 000 ha, or 23% of the floodplain, comprising most of the highest risk ASS, is now under active management for ASS remediation (Henderson et al, 2003). The NSW ASS Hotspot Remediation Program provided funding for the development and implementation of remediation works in the Collombatti-Clybucca area. The overall aim of the project which was managed by Kempsey Shire Council was to reduce the intensity, frequency and duration of acidic water discharges into receiving water bodies, and to restore scalded areas to productive pastures. The Macleay River Floodplain Project, an initiative set up in 2000 in partnership with Council, Government and local landholders, has also resulted in implementation of remediation works aimed at ASS issues in other areas of the estuary.

A summary of some features of the ASS hotspot areas is shown in **Table 5.1**. The locations of the hotspot areas are shown in **Illustration 5.1**. General descriptions of the areas and remediation projects are provided below.

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council and Department of Land and Water Conservation*




LEGEND

Study area
Acid sulfate soil hotspot areas

North

0 5 km

# Acid Sulfate Soil Hotspot Areas

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1352708

Illustration 5.1

**Table 5.1 ASS Hotspot Summary**

| | *Yarrahapinni* | *Collombatti – Clybucca* | *Belmore* | *Frogmore* | *Kinchela* | *Raffertys* |
|---|---|---|---|---|---|---|
| ASS Hotspot Area (ha) | 714 | 2,981 | 3,510 | 1,310 | 2,671 | 474 |
| Depth to oxidised sediments (m) | 0.1 – 0.4 | | < 0.5 | < 0.6 | < 0.5 | < 0.5 |
| Depth to water table (m) | 0.5 – 0.9 | 0.2 – 1.3 | 0.5 – 0.85 | Not reported | | |
| Flushing / dilution factors in receiving waterbody | Very favourable (Macleay River) | Moderately favourable (Clybucca Creek) | Flushing – Moderate; Dilution - Low (Belmore River) | Flushing – Moderate; Dilution - Low (Belmore River) | Low (Kinchela Creek) | Very High (Macleay River) |
| Land tenure | National Park (NP) | Private | Private / Crown | Private | Private / some NP | Private |
| Active Drainage Union | - | Yes | No | No | No | Yes |

Source: Naylor and Tulau, 1999.

### 5.1.1 Yarrahapinni

Yarrahapinni Broadwater is located off Andersons Inlet, an arm of the Macleay estuary. It was previously a large estuarine wetland. However in the early 1970s a levee was built, cutting off the five natural entrances to the Yarrahapinni Broadwater from Andersons Inlet. Additional drainage works at that time included five floodgates and the Yarrahapinni Drain.

These works excluded saline water, lowered the water table and converted the wetland from a tidal environment to a freshwater wetland allowing low level grazing. Soil and water acidification and areas of scalding within the wetland occurred, largely attributed to the artificial drainage works.

The Yarrahapinni Wetland Reserve Trust was established in 1996, with a three stage program to rehabilitate the area. The Trust ended in 2007 with the gazetting of the Yarrahapinni Wetlands National Park. A Restoration Plan for the wetlands has been prepared, focussing on the hydrological and groundwater/aquifer interactions (WRL, 2009). Interim flushing of the wetlands have been undertaken since December 2007 with the installation of two tidal flushing gates on the floodgates to enable partial tidal exchange in the lower reaches of the wetlands and fish passage. In February 2010 one of the tidal gates was opened entirely. A Plan of Management for the area is being prepared and implementation of restoration actions is now progressing in a staged adaptive management approach. It is considered this area does not need additional focus beyond the Plan of Management / Restoration Plan in regard to addressing ASS issues.

### 5.1.2 Collombatti-Clybucca

The Collombatti – Clybucca wetlands is located in the northern section of the Macleay floodplains. The wetlands are an extensive area of backswamps, situated around Collombatti Creek, upstream of Clybucca. This area, covering approximately 4,827 ha is privately owned land and the drainage system is managed by Seven Oaks Private Drainage Board (SOPDB). The area has a long history of drainage. The Collombatti – Clybucca wetlands are bisected by Seven Oaks Drain, linking the wetland to Clybucca Creek and the Macleay River. ASS is known to be extensive within the wetland.

Clybucca Floodgates prevent tidal ingress into the wetland. Artificial drainage and floodgates have excluded saline water, lowered the water table and resulted in soil and groundwater acidification. Oxidation of soils is known to occur to a depth of 1 m, representing a huge store of acid. Run-off from these soils causes acidification of Seven Oaks Drain and Clybucca Creek. Fish kills have been reported for years.

A management strategy has been developed and a number of remediation projects have been undertaken in the area under the ASS Hotspot Remediation Program. The project included consultation with private landowners, the drainage union, other government authorities and ASS specialists. Remediation strategies aimed at maintaining higher water levels in drains to help maintain a saturated upper soil profile and reduce groundwater seepage into the drains and thereby prevent further oxidation of the ASS horizon. Earthen weirs were installed in 2003 in the main feeder drains of the larger Seven Oaks drainage system. Projects also involved revegetation of acid scald areas to reduce evaporation of groundwater and prevent further oxidation of ASS material and reduce the accumulation of surface acid salts and therefore reduce associated surface acid flows (Kempsey Shire Council, 2004). The revegetation works included fencing of areas to exclude stock.

The majority of the proposed works were implemented and a monitoring program established. Initial results showed higher drain water levels maintained, and positive results from the exclusion of stock in ASS scald revegetation areas. The report recommended:

- further monitoring to quantify the impact of the remediation works;
- further research into:
  - the composition of acidity in acid water: what components there are besides sulfuric acid, and what role do they play in the ASS processes;
  - 'blackwater processes', and the relationship with ASS;
  - revegetation of ASS scalds using mulch and livestock exclusion.

Sluice gates were installed on two of the floodgates of the Clybucca Headworks to assist in saline neutralisation of acid waters upstream of the headworks. A management plan was developed for the sluice gates, however the SOPDB has not acted on the management plan due to concerns associated with the potential for saline water 'pushing' up the Seven Oaks Drain and inundating the upstream Mayes Swamp area potentially killing existing vegetation and leading to salt scalding (Kempsey Shire Council, 2004).

Wetlands Care Australia (WCA), with support from the NRCMA, is currently preparing a management plan for the Clybucca Floodplain Wetlands. The management plan will identify the major issues affecting the land, soil, water and biodiversity of the area. Priorities for management action across the floodplain will be identified and options for projects and funding listed (refer to **Section 4.1.2.2**).

### 5.1.3 Belmore Swamp

Belmore Swamp is a large backplain and backswamp approximately 13km east of Kempsey, in the south-eastern part of the Macleay floodplain. Before flood mitigation works, the area included 1300 ha of

seasonal freshwater wetlands. The Belmore Swamp has also been extensively modified for drainage and flood mitigation purposes.

The drainage system has drastically altered the water balance of the wetlands, which has caused oxidation of pyritic sediments, and increased acidity levels that are often toxic to aquatic life. Extremely acid clays occur within 0.5 m of the soil surface in many of the lowest areas. The watertable occurred at depths of 0.5 to 0.85 m (Naylor and Tulau, 1999).

A study was undertaken by Webb McKeown and Associates with Robert J Smith and Associates to prepare the Upper Belmore Floodplain Management Strategy. Objectives of the study were to determine the works required to improve land productivity and water quality. Potential management strategies included drain redesign, floodgate lifting devices, dropboard culverts and water quality monitoring. A number of remediation projects are also being undertaken in this area.

### 5.1.4 Frogmore

Frogmore is an area of backswamps approximately 6 km north-east of Kempsey, on the southern side of the Macleay River. The land surrounding Frogmore Drain and is privately owned and managed. Floodwaters are drained from the wetlands via Frogmore Drain into Belmore River.

Artificial drainage has impacted on water quality. ASS materials occur generally within 0.65 m of the soil surface (Naylor and Tulau, 1999).

Active management of the Frogmore area involves keeping one of nine cells on the Union Floodgates open in dry times to improve water quality upstream. A Management Plan has been developed and adopted by all connecting landowners and operates on an ongoing basis. Two tidal floodgates have also been installed in addition to improved lifting devices and twenty small, in-system water control structures installed to avoid undesirable pasture inundation.

### 5.1.5 Kinchela Swamps

The Kinchela Swamps are a large backswamp area at Kinchela Creek and Swan Pool, which is to the east of Belmore River and approximately 16km east-north-east of Kempsey. Most of the land in this area is privately owned, with some sections in the Upper Kinchela Creek within the Hat Head National Park. A SEPP 14 wetland is located in this area east of Kinchela Creek.

Flood mitigation works included floodgates, artificial drainage channels and levees. The area contains widespread actual acid sulfate soils. Extremely acid clays occur within 0.5 m of the soil surface in many of the lowest areas (Naylor and Tulau, 1999).

MASSLAG have trialled simple floodgate modifications to allow active water management involving on-site broadacre water retention. Henderson and Tulau (2001) identify active water management by containment of fresh water in drains as the most appropriate remediation strategy to address ASS issues in the Kinchela drainage area. Projects have addressed floodgates at Wilsons Drain, Council Drain, Irwins Drain and Bradleys Drain.

The Swan Pool Drainage Management Plan Final Report (Smith, 2002) and Kinchella Lock Floodgate and North Weir Management Plan (NPWS, 2008) provide a number of recommendations to address ASS issues. Kempsey Shire Council and NSW PWG have been progressively implementing actions that stem from these reports including modifications to “The Lock” structure on Kinchella Creek and changing of some landuse practices through land acquisitions (Alex Wyatt, PWG, pers. comm., 2008 cited in Telfer and Birch, 2009).

### 5.1.6 Raffertys

This section of wetlands, which lies approximately 20 km north-east of Kempsey, is a depression between Macleay River levee and coastal sand dunes between Hat Head and South West Rocks. Raffertys drain is located in this area, with smaller feeder drains and large floodgates near the river.

The drainage system has been known to discharge acidic, iron and aluminium rich water during dry periods and black, low-dissolved oxygen water after heavy rainfall or flood events (Australian Government, 2007b). The Macleay River is saline and is thought to provide some buffering effect where Raffertys Drain enters the river.

In 2004 a large portion of the old deep drain was replaced by a 30m wide shallow v-drain. In 2005 a tidal floodgate was installed on the head works to improve water quality in the remaining section of the existing drain. These works have addressed acid production and run-off as well as improved pasture production. Results have shown improved water quality and increased wet pasture management (Australian Government, 2007b:4).

## 5.2 Issues

The environmental issues associated with ASS in the Macleay estuary include:

- accelerated formation of ASS from artificially controlling water regimes;
- dewatering of waterways creating AASS;
- fish kills from water deoxygenation in waterways, via decomposition of water intolerant flora;
- fish kills from acid runoff;
- ASS decreasing potential landuses;
- earthworks within ASS prone land;
- aquatic life being killed or limited by heavy metals which are released into waterways, via ASS mobilisation with runoff;
- vegetation death or limited growth from acid scalds; and
- water quality degradation.

Active water level management is one of the most appropriate remediation strategies to address ASS. General actions to facilitate active management in drains and revegetation of acid scald area are:

- allow saline water ingress into floodgated areas to provide tidal flushing and buffering of acid water with saline water;
- retrofit existing floodgates to allow controlled water volumes to move through waterways (developments in floodgate modification is are contained in NSW Department of Industry and Investment (2009), Johnston S. *et. al.* (2003), and NSW Fisheries (2002))
- install earthen weirs in drains to maintain higher water levels;
- replace or fill drains so they are shallower to reduce groundwater seepage into the drains; and
- revegetation of ASS scalds – mulching / water levels / livestock exclusion.

## 5.3 Management Objectives

The general strategies or management objectives to address ASS have been based on previous studies and projects and specific objectives developed by the Coast and Estuary Management Committee:

***Management Objective 5/1*** active water management by maintaining higher water levels in drains to help maintain a saturated upper soil profile and reduce groundwater

| | |
|---|---|
| | seepage into the drains and thereby prevent further oxidation of the ASS horizon; |
| ***Management Objective 5/2*** | revegetation of acid scald areas to reduce evaporation of groundwater and prevent further oxidation of ASS material and reduce the accumulation of surface acid salts and therefore reduce associated surface acid flows; |
| ***Management Objective 5/3*** | coordinate and integrate all existing projects and activities on ASS issues throughout the lower Macleay. |

## 5.4 Management Strategies

This issue is intrinsically linked with drainage management issues, therefore strategic management actions that relate to ASS management are formulated in **Section 6 – Floodgate and Drain Management**.

# 6

# Floodgates and Drain Management

## 6.1 Current Status

Kemsley (2001) notes that since the early 1900s the Macleay floodplain has been extensively modified. In 1949 and 1950 significant floods initiated the Macleay Flood Mitigation Scheme which was implemented between the 1950s and 1970s. The scheme included construction of floodgates, drains and levees. The Macleay River flood mitigation scheme now consists of approximately 180 floodgated structures, 147 km of drains, 34 km of levees and 37 km of bank protection works (Manly Hydraulics Laboratory, undated).

Floodgates have been installed for the purposes of preventing back-flooding of creeks and tributaries and subsequently preventing inundation of agricultural land in the Lower Macleay from the Macleay River system during minor flood events.

The majority of floodgates in the Macleay system are minor and consist of flap controlled pipe outlets from protected property areas to watercourses. These all operate hydrostatically allowing water to discharge through the pipe system whenever the water level on the river side is lower than the water level on the protected property side (Kempsey Shire Council, 2009). In addition to the minor floodgate structures, several larger structures exist including:

- Belmore River Floodgates (spanning the river) (manually operated);
- Belmore River Flood Control Structure (adjoining the river) (manually operated);
- Kinchela Creek Floodgates (manually operated);
- Kinchela Creek Right Bank Control Gate (manually operated);
- Kinchela Creek Left Bank Control Gate (manually operated);
- Ryans Cut Floodgates (hydrostatically operated with mechanical assistance as required to remove sand buildup on the downstream side);
- Killick Creek Floodgates (hydrostatically operated);
- Menarcobrinni (Cybucca Creek Headworks) Floodgates (hydrostatically operated); and
- Christmas Creek Floodgates (hydrostatically operated) (Kempsey Shire Council, 2009).

Management of floodgates and flood control structures by Council falls under three categories or stages: during floods; immediately after a flood event; and non-flood periods. The primary objective of the first two stages is flood mitigation, the objective of the third stage is improved ecological, water quality and land management outcomes as described below:

- **Stage 1 - during floods**: All floodgates and flood control structures are closed pending a flood event. This action is taken to keep water within the Macleay River and prevent the water from dissipating into the low lying areas of the floodplain. Flood control structures are then opened and/or closed by Council during flood events for water level management. Operation of floodgates are undertaken in accordance with Council's *Procedure for Flood Event for Flood Controller*;
- **Stage 2 - immediately post-floods**: Operation of the floodgates are similar to the 'during floods' procedures however main floodgates across Belmore River and Kinchella Creek are lifted to allow tidal exchange when tidal influence returns based on mutual agreements between Council and NSW I&I (Fisheries) and adjoining landholders;
- **Stage 3 - non-flood periods**: the goal during non-flood periods is active floodgate management to achieve improved ecological, water quality and land management outcomes.

In general, the flood mitigation system of floodgates and drains and their management has had a significant and detrimental impact on floodplain wetlands, and acid sulfate soil management and water quality.

Kempsey Shire Council in association with individual landholders, community-based organisations such as MASSLAG, industry representatives such as Oyster Growers, and government agencies has been addressing floodgate and drain management issues through the Macleay River Floodplain Project since January 2000. Projects have included developing management plans for major drainage areas and on-ground rehabilitation projects including drain and floodgate modifications. These are described further in **Section 6.1.2** in relation to the main drainage areas.

### 6.1.1 Management of Floodgates and Drains

Management requirements and responsibilities relating to of drains and floodgates on the Macleay fall into three categories:

1. drains and structures constructed for the former Macleay River County Council that are now the responsibility of Kempsey Shire Council;
2. drains and structures constructed and managed by drainage unions. Ten drainage unions have been formed on the Macleay River floodplain, however only two unions are currently considered active (Seven Oaks Private Drainage Board and Rafferty Private Drainage Board). In addition, other unions can become activated in response to particular issues or events;
3. drains constructed by individual landholders. Such drains are located within property boundaries (or former property boundaries), and are generally relatively small. These drains may be connected to Council or union drains (Tulau and Naylor, 1999).

### 6.1.2 Drainage Areas

For the purposes of this report, the drainage areas are divided into similar areas as the major wetland areas discussed in **Section 4**. The following provides a description of each area, associated current or past modification projects and the general issues within each area. The drainage areas are shown in **Illustration 6.1** to **6.6**.

#### *6.1.2.1 Yarrahapinni*

The Yarrahapinni wetlands were among the last wetlands on the Macleay floodplain to be drained. In the early 1970s the four islands that once formed the entrance to the system from Andersons Inlet were joined with a bund wall levee and floodgates were installed across the easternmost end of the levee. Drainage pathways were deepened and straightened. The flood mitigation works were for the purpose of potential improvement in agricultural production and flood hazard reduction. The works control the flow of water into the wetlands and assist in the management of small nuisance flood events.

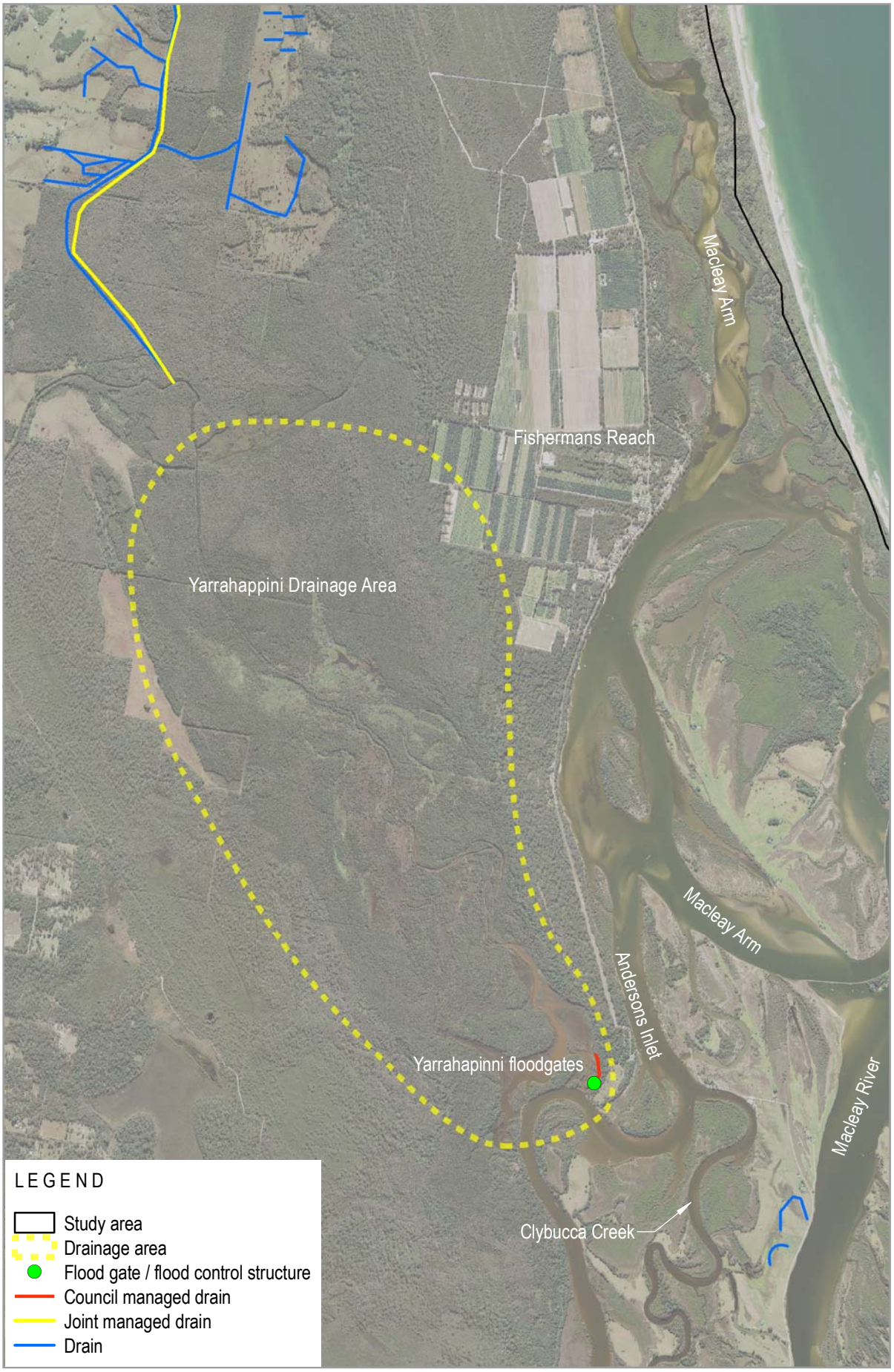
Issues arising from drainage of Yarrahapinni Wetlands include the development of a significant acid pool from the lowering of water table levels, acid scalds, and loss of mangroves and saltmarsh communities.

The Yarrahapinni Wetland Reserve Trust was established in 1996, with a three stage program to rehabilitate the area (the Trust ended in 2007 with the gazetting of the Yarrahapinni Wetlands National Park). Various studies were undertaken between 1997 and 2004 focussed on determining:

- the hydraulic effect of opening floodgates;
- environmental impact of partial and complete tidal inundation;
- the environmental impact of tidal restoration on vegetation;
- the existing flora, fauna and water quality conditions;
- holistic management plans of the restored environment; and
- water quality and flora response during short-term trial flood gate openings.

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*




0 800

North

# Yarrahappini Drainage Area

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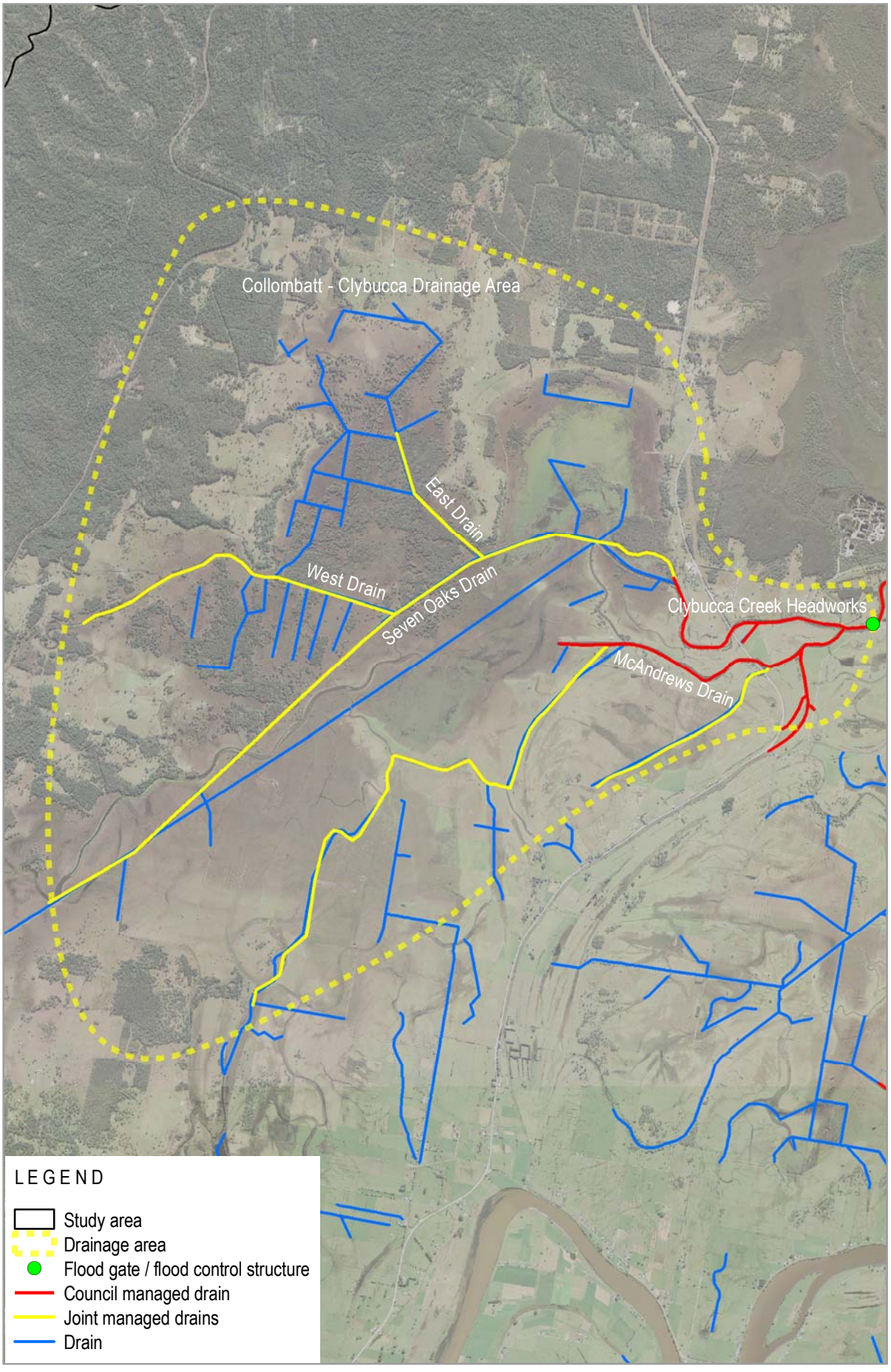
Illustration 6.1

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*



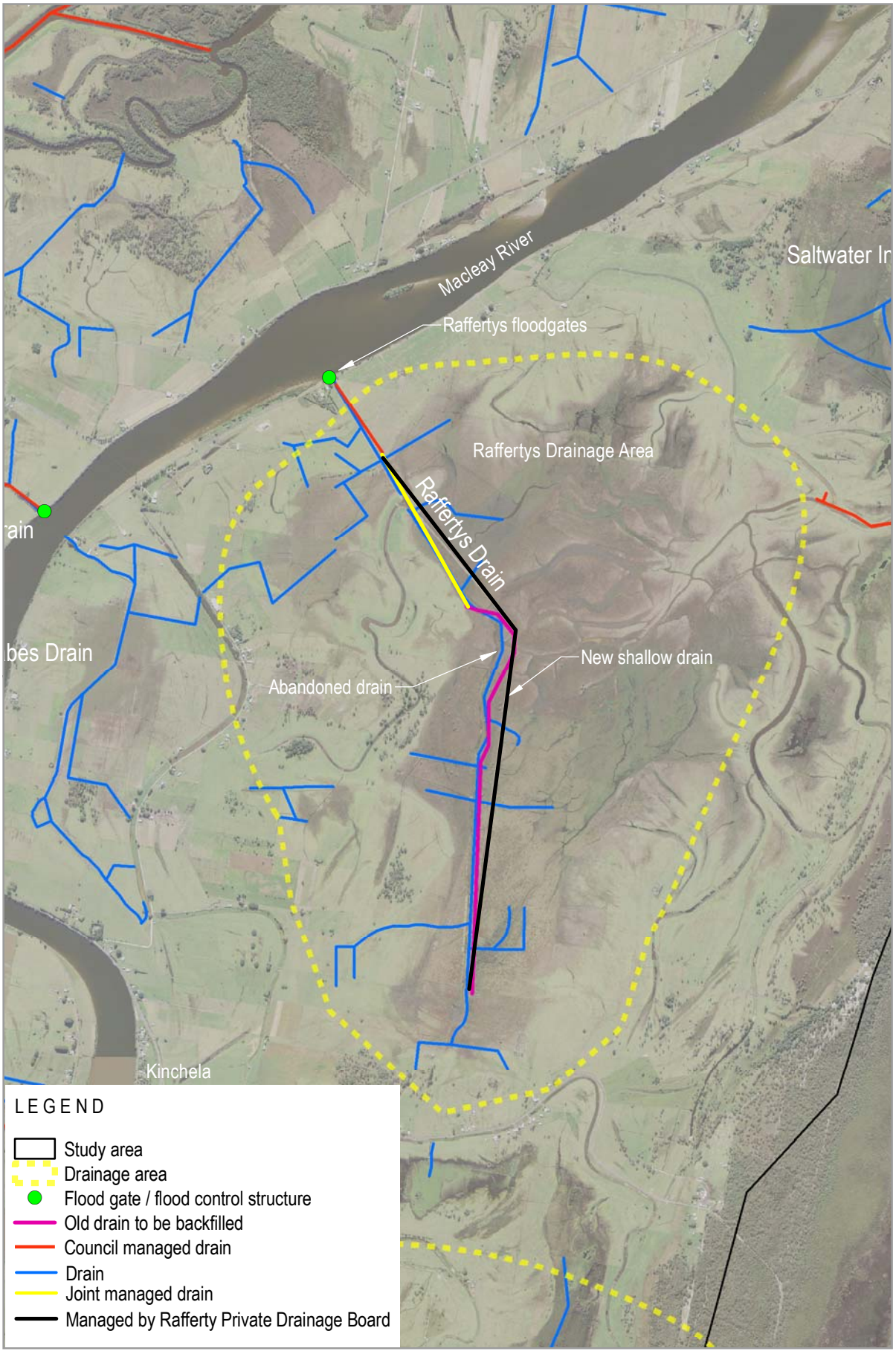

0 1.2 km

North

# Collombatti - Clybucca Drainage Area

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*




0 800

North

# Raffertys Drainage Area

GeoLINK environmental management and design

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1352791

Illustration 6.3

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*


0 1.5 km

North

# Kinchella Drainage Area

GeoLINK environmental management and design

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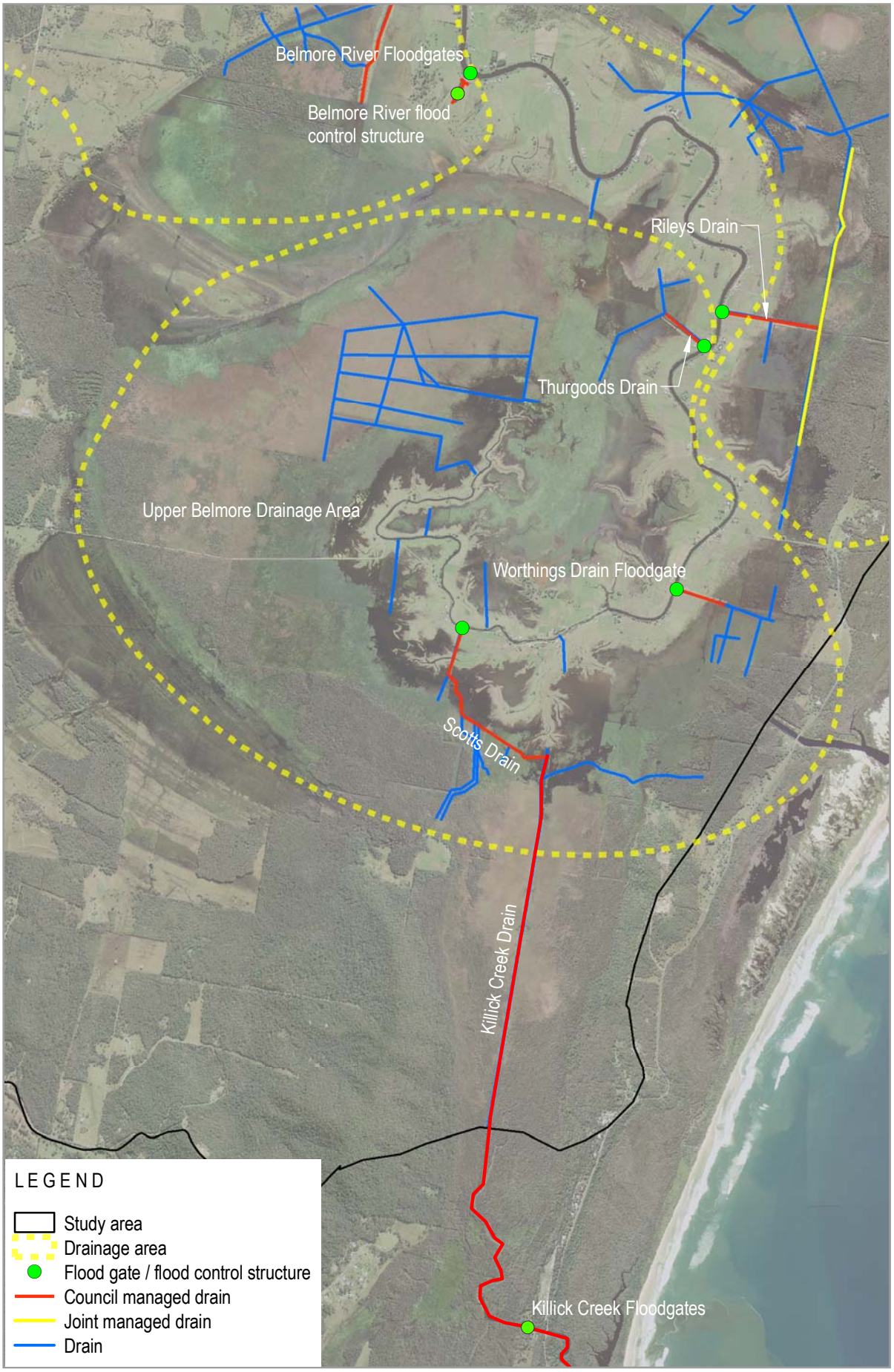
Illustration 6.4

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*



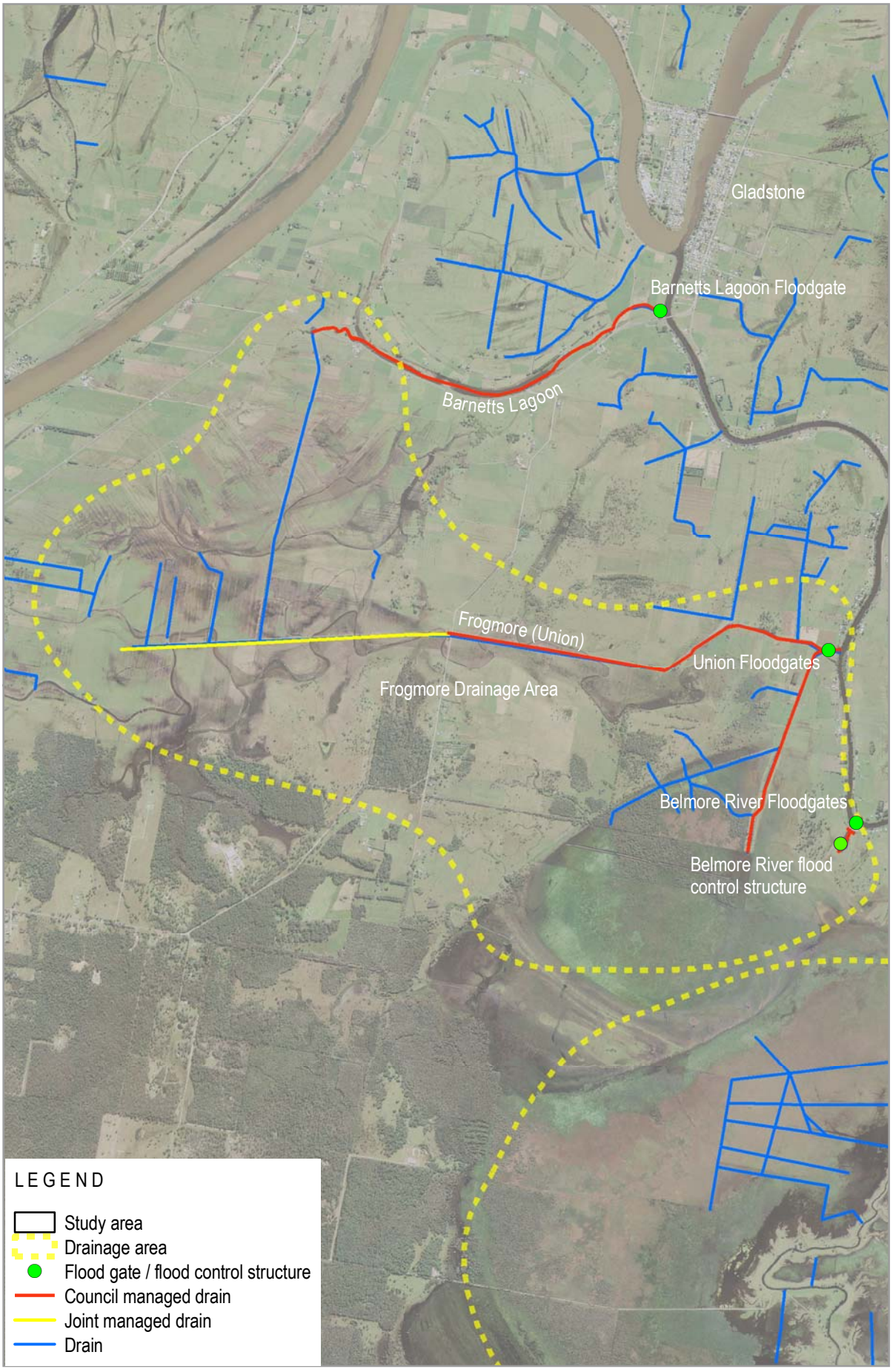

0 1 km

North

# Upper Belmore Drainage Area

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*




0 1 km

North

# Frogmore Drainage Area

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352794

Illustration 6.6

In April 2007 600 ha of the wetland complex was gazetted under the Yarrahapinni Wetlands National Park. The park is managed by the Yarrahapinni Wetlands Working Group under the control of Department of Environment, Climate Change and Water (DECCW) – Parks and Wildlife Group. A plan of management for the area is being prepared and implementation of remediation actions is now progressing in a staged adaptive management approach. PWG is now pursuing the full rehabilitation of the wetlands, with the end goal of restoring the wetlands to a natural state reminiscent of the site prior to the flood mitigation works. A Restoration Plan for the wetlands has been prepared, focussing on the hydrological and groundwater/aquifer interactions (WRL, 2009). This report now forms the basis of the Yarrahapinni Wetlands Rehabilitation Project. This report recommended the following:

- Stage 1: Establish trigger points and management protocols: aimed at determining the risks and trigger points for water level, salinity, surface water quality, groundwater quality, onsite erosion etc. These trigger points would then guide management protocols and contingency plans should they be exceeded;
- Stage 2: On-site preparatory work and design: aimed at preparing the site to assist in future monitoring and data collection. Works would include determining the dimensions of the bund wall levee, installing peizometers, designing the upstream levee, LiDAR data collection and any associated modelling tasks;
- Stage 3: Initial on-ground works: including floodgate modification, upstream levee construction, upstream inflow works and preparatory work for the bund wall levee deconstruction;
- Stage 4: Initial restoration works: opening of the floodgate culverts and site monitoring; and
- Stage 5: Incremental or full restoration works: aimed at removal of the bund wall levee in a staged approach to minimise risk to stakeholders and the environment.

Interim flushing of the wetlands has been undertaken since December 2007 with the installation of two tidal flushing gates on the floodgates to enable fish passage and partial tidal exchange in the lower reaches of the wetlands and fish passage. In February 2010 one of the tidal gates was opened entirely. Council owns and manages operation of the floodgates.

#### *6.1.2.2 Collombatti-Clybucca*

The Collombatti-Clybucca drainage scheme is the largest in the Macleay estuary. The flood mitigation scheme included extension of Andersons Inlet modifying Clybucca Creek, construction of Seven Oaks Drain connecting Collombatti Creek to Clybucca Creek installing the Clybucca floodgates (Cybucca Headworks), constructing McAndrews Drain, and construction of associated levees using the material excavated from the drains.

The Clybucca Headworks is a series of 21 floodgates that prevent tidal and river freshes inundating upstream areas of land via Clybucca Creek. In the 1970s Seven Oaks Drain and significant side drains (eg. east drain and west drain) were lengthened, widened and deepened with the intention to drain the lowest lying areas to improve agricultural productivity. The management and maintenance of the major drains within the drainage system is overseen by the Seven Oaks Private Drainage Board (SOPDB). Any remediation works within the drains requires endorsement by the SOPDB (Kempsey Shire Council, 2004).

Prior to flood mitigation works Clybucca Creek was a narrow, winding creek that would have had limited salt water exchange. Since construction of Andersons Inlet, rapid exchange of saline tidal waters between the Macleay and the Clybucca Headworks is now possible. Without the headworks it is likely that saltwater could extend up the Seven Oaks Drain to areas that did not experience tidal exchange prior to the mitigation works (Kempsey Shire Council, 2004).

This area is relatively sparsely populated. Properties are typically larger than 40 ha in area. The area incorporates backswamp areas and adjoining higher ground such as levees and foothills. Most dwellings

are located on the higher ground. Until the 1960s when many farms converted to beef-cattle grazing, the agricultural activity in the area was dairy industry. Minor areas of higher ground include fodder crops.

The Macleay estuary downstream of the Clybucca Headworks is an important fishery supporting an oyster industry and being a popular destination for recreational fishing (Kempsey Shire Council, 2004).

Over-drainage of the backswamps in this area has increased exposure and oxidation of underlying ASS causing significant acid scalding, and reduced agricultural productivity, and producing a degraded wetland habitat value. The drains also regularly discharge poor water quality (low pH, low dissolved oxygen and high aluminium levels) to the Macleay River via Clybucca Creek. Drainage of the backswamp areas has also enabled establishment of non-water-tolerant pastures. During extended flood events, these pastures decompose and consequently deplete oxygen levels in the floodwaters.

In 2001 Council and the Department of Land and Water Conservation (DLWC) initiated the Collombatti – Clybucca ASS Hot Spot project, to implement remediation strategies to reduce the frequency, intensity and duration of acid water discharge events. The project included consultation with private landowners, the drainage union, other government authorities and ASS specialists. A proposed management strategy was prepared: the Collombatti-Clybucca Acid Sulfate Soils Hot Spot Management Plan. The majority of the proposed works were implemented and a monitoring program has been established.

Remediation projects have included construction of earthen weirs in the main feeder drains (East Drain and West Drain) of the larger Seven Oaks drainage system to maintain higher drain water levels to reduce groundwater seepage into the drains and thereby assist in maintaining a saturated upper soil profile to reduce oxidation of the ASS horizon. Projects also involved revegetation of acid scald areas.

Initial results from the remediation projects showed higher drain water levels were maintained, and there were positive results from the exclusion of stock in ASS scald revegetation areas.

Preliminary investigations have been initiated in regard to the use of shallower drains for flood mitigation purposes to replace the deeper Seven Oaks Drain. Investigations have included the use of older, abandoned drains. However no detailed modeling has been undertaken to date (R. Kemsley, *pers. comm.*).

Sluice gates were installed on two of the floodgates of the Clybucca Headworks and a management plan was developed for the sluice gates prior to the Collombatti – Clybucca ASS hot spot project. The purpose was to:

- provide fish passage to the downstream side of the structure during periods of poor water quality on the upstream side; and
- assist in saline neutralisation of acid waters upstream of the headworks.

The SOPDB has not acted on the management plan for the sluice gates due to concerns associated with the potential for saline water 'pushing' up the Seven Oaks Drain and over the earthen weirs in east drain (which have a height of -0.2 m AHD) and inundating the upstream Mayes Swamp area potentially killing existing vegetation and leading to salt scalding (Kempsey Shire Council, 2004).

The Clybucca Headworks have been assessed for maintenance works with significant costs required to address urgent repairs to floodgates and concrete cancer in the main structure.

Wetlands Care Australia (WCA), with support from the NRCMA, is currently preparing a management plan for the Clybucca Floodplain Wetlands. The management plan will identify the major issues affecting the land, soil, water and biodiversity of the area. Priorities for management action across the floodplain will be identified and options for projects and funding listed (refer to **Section 4.1.2.2**).

### 6.1.2.3 *Raffertys*

Raffertys is an acid sulfate soil hotspot, draining approximately 20 km² of backswamp and wetland area with an average elevation of 0.0m AHD (Australian Government, 2007b). The area is bisected by a 4km drainage channel, Raffertys Drain, which is managed by Council. The drainage system includes smaller feeder drains managed by landowners, and the Council managed floodgate at the junction with Macleay River. The drainage area is actively managed by the Rafferty Private Drainage Board.

Historical deep drainage system.

The drainage system has been known to discharge acidic water during dry periods and low-dissolved oxygen water after heavy rainfall or flood events (Australian Government, 2007b).

A management plan was developed by 2002 under the Macleay River Floodplain Project and adopted by the Rafferty Private Drainage Board. By 2004 3 km of the old deep drain had been decommissioned and replaced by a 30m wide shallow v-drain. All connecting secondary drainage lines were reshaped and redirected to assist in efficient flood water removal (Australian Government, 2007b:4).

Filling in the old drain.

In 2005 a tidal floodgate was installed on the head works to improve water quality in the remaining section of the existing drain. A management plan has been developed for the floodgate (Australian Government, 2007b:4).

The above works have addressed acid production and run-off as well as improved pasture production. Results have shown improved water quality and increased wet pasture management (Australian Government, 2007b:4).

New shallower drainage system.

Source: (Australian Government, 2007b)

### 6.1.2.4 *Kinchela*

The Kinchela drainage area includes the backswamp area at Kinchela Creek and East Kinchela Swamp (Swan Pool). Most of the land in this area is privately owned, with the exception of Parks and Wildlife Group owning the majority of the land incorporating the East Kinchela Swamp.

Flood mitigation works included floodgates, artificial drainage channels and levees. The main floodgates in this area are the Kinchela Creek Floodgates, Kinchela Creek Left Bank flood control structure and Kinchela Creek Right Bank flood control structure. During smaller flood events the two flood control structures (on the left and right bank of Kinchela Creek) are manually closed to prevent nuisance flooding

of the backswamp areas. During large flood events these two flood control structures are opened and/or closed for water level management. During extreme flood events, these two flood control structures are opened to allow backfilling of the two swamp areas and subsequently reduce the river peak at that time.

When flood waters in the Macleay River subside the swamps are drained by a number of floodgated drains and channels.

Some of the main drains include Wilsons, Bradleys Creek, Swanpool, Irwins, McNallys, Hoffmans, Schoolhouse, Gladstone and Slaughterhouse Drains which are managed by Council. A floodgate structure known as Kinchela Lock (or 'The Lock') is positioned at the point where Kinchela Creek opens out into the East Kinchela Swamp (Swan Pool) in order to prevent unwanted saltwater intrusion during dry times. East Kinchela Swamp is also connected to Korogoro Creek via a floodgated drain. This drain operates automatically once floodwaters in the swamp reach a certain height. Kinchela Lock is now owned and managed by the Parks and Wildlife Group and will be subject to a management plan administered by the PWG.

Issues associated with flood mitigation include the decomposition of non-water-tolerant pastures, subsequent effects on the quality of the discharged water and large fish kills. The water quality of Kinchela Creek has suffered negative effects associated with drainage and the exposure of acid sulfate soils.

MASSLAG have trialled floodgate modifications for the purpose of 'decanting' water from Kinchela Creek into the drainage system and controlling the depth of water in the drainage system. Projects have addressed floodgates at Wilsons Drain, Council Drain, Irwins Drain and Bradleys Drain.

The Swan Pool Drainage Management Plan Final Report (Smith, 2002) and Kinchella Lock Floodgate and North Weir Management Plan (NPWS, 2008) provide a number of recommendations to address ASS issues. Kempsey Shire Council and NSW PWG have been progressively implementing actions that stem from these reports including modifications to the Kinchela Lock structure and changing of some landuse practices through land acquisitions (Alex Wyatt, PWG, pers. comm., 2008 cited in Telfer and Birch, 2009).

#### *6.1.2.5 Upper Belmore*

The Belmore Swamp is an extensive swamp area surrounding the upstream reaches of the Belmore River. The area is privately owned, apart from areas in the centre of the swamp, which are Crown and leasehold land.

The Belmore Swamp has also been extensively modified for drainage and flood mitigation purposes. Floodgate structures include Belmore River Main Floodgate (spanning the river) and the Belmore River Flood Control Structure (on the left bank of the river immediately downstream of the main floodgates). The structures are manually operated based on the same protocol as the Kinchela foodgates: closed during smaller flood events to prevent nuisance flooding, and opened and/or closed in larger flood events top manage flood water levels. This may include allowing flood water within the river to flow into the floodplain and subsequently reduce the river peak at that time.

There are also major drainage structures that connect the Belmore Swamp to Killick Creek (Scotts Drain / Killick Creek Cut floodgate) and to the Pacific Ocean (Ryans Cut). The Killick Creek system includes Scotts Drain floodgates on the northern outlet of the system and Killick Creek Cut floodgate on the southern outlet with approximately 10 km of mitigation drains between the two outlets. The floodgates at Ryans Cut provide a more direct route for the discharge of water from the floodplain to the ocean. The Ryans Cut floodgates are operated hydrostatically, although at times it may be necessary to provide mechanical assistance by way of removing sand build up on the ocean side of the flood gate structure.

Drainage issues in the Belmore area relate to over drainage of ASS producing acid runoff, poor water quality and acid scald areas. Over drainage has also resulted in the replacement of water tolerant pasture

species with non-water-tolerant species. Issues associated with floodwater storage include the decomposition of non-water-tolerant pastures, subsequent effects on the quality of the discharged water.

The Upper Belmore Floodplain Management Strategy was developed for the drainage area. Objectives of the study were to determine the works required to improve land productivity and water quality. Potential management strategies included drain redesign, floodgate lifting devices, dropboard culverts and water quality monitoring. Subsequent remediation projects in the Belmore drainage area have focussed on managing optimum water levels in the drainage system. Projects have included design modifications to Scotts Drain floodgates to facilitate active water management in the drains and over acid scald areas. The Scotts Drain floodgates have a management plan and are actively managed.

#### *6.1.2.6 Frogmore*

Frogmore is an area of backswamps approximately on the southern side of the Macleay River and west of Belmore River. The land surrounding Frogmore Drain is privately owned and managed. Floodwaters are drained from the wetlands via Union Drain (or Frogmore Drain and Darkwater Drain) into Belmore River. Union Drain is managed by Kempsey Shire Council.

The drainage has impacted on water quality with monitoring indicating that water within the drain often contains very low pH, and is toxic to aquatic life.

Active management of the Frogmore area concerns the large floodgate structure (Union Floodgates) to facilitate improved tidal flushing and increase fish passage and habitat. Management involves keeping some of the gates permanently opened in non-flood periods to allow water ingress from the Belmore River into the drainage system. Smaller in-system structures (flap gates with drop board provisions) have been positioned to prevent undesirable flooding of pastures. A Management Plan has been developed and adopted by all connecting landowners and operates on an ongoing basis.

### 6.1.3 Floodgate Management for Fish Passage

NSW Fisheries (now Primary Industries - Industry & Investment NSW) conducted a desktop assessment of the 180 floodgate structures owned by Council to prioritise their suitability for active management - controlled opening of a floodgate during non-flood times for the purposes of allowing tidal water to enter the affected waterway (NSW Fisheries, 2002). The floodgates were prioritised on the basis of fish habitat of the drains and landholder willingness to trial active floodgate management. Apart from improved fish passage, other broader objectives for the active management were: improvements in water quality and water discharges; rehabilitation of native vegetation on land affected by floodgates and drains; improved farm pasture/crop management; and enhanced drought fodder availability. Twenty four (24) floodgates were assigned a high priority for active floodgate management. These results have been used in **Section 6.4** to assist in prioritising drainage areas for management actions.

The report outlines a methodology for developing floodgate management plans, giving two examples plans (Marriot's floodgates and Clancy's floodgates).

### 6.1.4 Wet Pasture Management

Primary Industries - Industry & Investment NSW previously ran the Floodplain Grazing Project for graziers using coastal swamp and floodplain areas. The project aim was to raise grazier's awareness & knowledge of best management practices for the use of wet pasture systems to remediate acid sulfate soils. The project promotes growing native wet pasture in suitable low-lying backswamp areas by reinstating more natural drainage in these areas. The benefits can be improved pastures, reduction in ASS issues, and improved water quality and habitat.

Trials looking at the quality and quantity of water couch growing at Clybucca were undertaken in 2004. The results indicated that water couch is a highly nutritious pasture species that grows well in shallow ponded areas (Australian Government, 2007c).

The Floodplain Grazing Project is no longer active within Primary Industries due to lack of funding. However, further education through a grazing management program is currently being delivered by Agricultural Information and Monitoring Service (AIMS) with funding from the Northern Rivers Catchment Management Authority. The Macleay floodplain is one of the designated areas for the program which includes wet pasture management. AIMS have indicated they expect to establish the program in the Macleay in the near future (Kahn, 2010).

### 6.1.5 Detailed Surface Elevation Information

Land and Property Management Authority (LPMA) have obtained detailed surface elevation data for the Kempsey area using Light Detection and Ranging (LiDAR) technology. The information has been made available to Council in 2010. The main product from the LiDAR data will be a 'bare earth' Digital Elevation Model (DEM) devoid of vegetation and man-made features with vertical accuracy in the range of 10 to 30 cm (Australian Government, 2007a). This data can be used for detailed computer hydraulic modelling of the drainage areas in the Macleay River estuary. His can be potentially used for broadscale analysis of drainage and floodgate modifications. The use of this data is discussed further in **Section 6.6**.

## 6.2 Issues

The environmental issues associated with floodgate and drainage management relate to over-drainage of backswamps increasing exposure and oxidation of underlying ASS causing significant acid scalding and poor water quality, reduced agricultural productivity, and degraded wetland habitat value. Drainage of the backswamp areas has also enabled establishment of non-water-tolerant pastures. During extended flood events, these pastures decompose and consequently deplete oxygen levels in the floodwaters.

Management of floodgates and drains is the main tool for dealing with the previous two estuary issues: floodplain wetlands and acid sulfate soils. To achieve effective management of floodgates and drains the following issues require attention (as identified by the Coast and Estuary Management Committee):

- administrative issues such as ownership, maintenance and the approval process for modifying floodgates and drains;
- availability of real time water quality and water level data to assist in floodgate management including public access to water quality data;
- improved information on the relationship between tidal processes and salinity and water levels within the drainage system;
- consistency of objectives of floodgate management with broad goals of estuary health;
- landholder management and agreements associated with floodgate and drainage systems; and
- funding for on-going remediation and management projects.

To assist the above process this estuary management study has investigated:

- ownership of the major floodgate structures and drains;
- the feasibility of Council and/or State Government taking ownership (and therefore management responsibility) for floodgates and drains; and
- prioritising floodgate and drainage systems in respect to impacts of drainage areas on estuary health.

## 6.3 Ownership of Floodgates and Drains

### 6.3.1 Current Ownership of Major Floodgates and Drains

A list of the main floodgates in the Macleay system is shown in **Table 6.1**. The table shows ownership and management details of the floodgates and associated drains. There are a number of drains in which ownership is yet to be determined.

**Table 6.1 Ownership of Major Floodgates**

| *Gate Name / (Identification No.)* | *Gate Ownership* | *Upstream Drain Name / ID* | *Drain Ownership* | *Drainage Area* | *Actively Managed (Yes/No)* | *Management Plan (Yes/No)* | *Comments* |
|---|---|---|---|---|---|---|---|
| Yarrahapinni (009G1) | Council / PWG | Yarrahapinni Drain | PWG | Yarrahapinni | Yes | Yes | |
| | | | | | | | |
| Cybucca Headworks (001G1) | Council | Clybucca Creek | Council | Collombatti-Clybucca | No | No | Menacrabinni Floodgates |
| | | Seven Oaks Drain | property landowners | Collombatti-Clybucca | N/A | N/A | |
| | | East Drain | property landowners | Collombatti-Clybucca | N/A | N/A | Low level weir installed |
| | | West Drain | property landowners | Collombatti-Clybucca | N/A | N/A | Low level weir installed |
| | | McAndrews Drain | Council | Collombatti-Clybucca | No | No | |
| | | | | | | | |
| Raffertys (070G1) | Council | Raffertys Drain | Council / Rafferty Private Drainage Board | Raffertys | Yes | Yes | fitted tidal floodgate |
| Saltwater Inlet (073G1) | Council | Saltwater Creek | Council | Raffertys | Yes | Yes | fitted tidal floodgate |
| | | | | | | | |
| Gladstone Gates (019G1) | Council | Gladstone Drain | Council | Kinchela | No | No | |
| Slaughterhouse (028G1) | Council | Slaughterhouse Drain | property landowners | Kinchela | No | No | |

| *Gate Name / (Identification No.)* | *Gate Ownership* | *Upstream Drain Name / ID* | *Drain Ownership* | *Drainage Area* | *Actively Managed (Yes/No)* | *Management Plan (Yes/No)* | *Comments* |
|---|---|---|---|---|---|---|---|
| Miles (023G1) | Council | Miles Drain | Drainage Union (however, no longer operational) | Kinchela | No | No | |
| Schoolhouse (027G1) | Council | Schoolhouse Drain | Council | Kinchela | No | No | |
| Kinchella Creek Right Bank Flood Control Structure (168G1) | Council | Kinchela East Floodway | Council | Kinchela | Yes | No | Open in non-flood periods |
| Kinchella Creek Left Bank Flood Control Structure (025G1) | Council | Kinchela West Floodway | Council | Kinchela | Yes | No | Open in non-flood periods |
| Kinchella Creek Floodgate (024G1) | Council | Kinchela Creek | Council | Kinchela | Yes | No | |
| Hoffmans (029G1) | Council | Hoffmans Drain | Council | Kinchela | No | No | |
| McNallys (032G1) | Council | McNallys Drain | Council | Kinchela | No | No | |
| The Lock (no specified ID) | DECCW - PWG | Kinchella Creek | DECCW – PWG? | Kinchela | Yes | No | |
| Rileys (022G1) | Council | Rileys Drain | Council | Kinchela | No | No | Connected with Kinchela No.2 Drain. Discharges to Belmore River |
| | | | | | | | |
| Belmore River Floodgate (017G1) | Council | Belmore River | Council | Belmore | Yes | No | |
| Belmore River Flood Control Structure (016G1) | Council | Belmore Floodway | Council | Belmore | Yes | No | Open in non-flood periods |

| *Gate Name / (Identification No.)* | *Gate Ownership* | *Upstream Drain Name / ID* | *Drain Ownership* | *Drainage Area* | *Actively Managed (Yes/No)* | *Management Plan (Yes/No)* | *Comments* |
|---|---|---|---|---|---|---|---|
| Thurgoods (021G1) | Council | Thurgoods Drain | Council | Belmore | Yes | Yes | |
| Worthings (020G1) | Council | Worthings Drain | Council | Belmore | No | No | |
| Scotts (088G1) | Council | Scotts Drain | Council | Belmore | Yes | Yes | |
| | | | | | | | |
| Union Floodgates (015G1) | Council | Darkwater / Frogmore Drain | Council | Frogmore | Yes | Yes | |
| Barnetts (031G1) | Council | Barnetts Drain | Council | Frogmore / Austral Eden | No | No | |
| | | | | | | | |
| Clancys (005G1) | Council | Clancys Drain | Council | Cooroobongatti | Yes | Yes | |
| Summer Island (033G1) | Council | Summer Island Drain | Council | Cooroobongatti | No | No | |
| McCabes (004G1) | Council | McCabes Drain | Council | Cooroobongatti | No | No | |
| Collins (006G1) | Council | Collins Drain | Council | Cooroobongatti | No | No | |
| | | | | | | | |
| Euroka Creek (010G1) | Council | Euroka Creek | Council | Euroka | Yes | Yes | Open in non-flood periods |
| | | | | | | | |
| Pola Creek (120G1) | Council | Pola Creek Side Drain | Council | East Kempsey | No | Yes | |
| | | | | | | | |
| Glenrock (011G1) | Council | Glenrock Drain | Council | Christmas Creek | No | Yes | |
| Christmas Creek (013G1) | Council | Christmas Creek | Council | Christmas Creek | Yes | Yes | Open in non-flood periods |

### 6.3.2 Changes to Ownership of Floodgates and Drains

Changes in ownership to private drains and floodgates will require landholder agreement for the ownership transfer and/or creation of easement over the assets to facilitate maintenance access.

It is noted that in respect to Private Drainage Boards (as constituted by s 197 of the Water Management Act 2000), DECCW - NSW Office of Water is investigating amending the Water Management (General) Regulation 2004 to enable the Governor to more easily dissolve any Private Drainage Board that has been inactive for a yet to be determined period (P. Pahlow, *pers. comm.*). However, this proposal may be rejected.

## 6.4 Priority Drainage Areas

The main drainage areas described in **Section 6.1** have been assessed and ranked to determine the higher priority drainage areas for remediation works in regard to improving estuary health. The criteria used in the assessment attempted to encompass the issues of floodplain wetlands, ASS, water quality impacts, fish passage, and administrative issues regarding effectively implementing actions. The assessment is summarised in **Table 6.3**. The criteria used in the assessment comprised:

- the total ASS hotspot area in each drainage region (as defined by Tulau and Naylor, 1999): a larger total area is given a higher score in regard to priority due to the potential to have a larger impact on the estuary;
- the environmental susceptibility of the receiving water body to poor water quality from the drainage area. This is based on the flushing / dilution factors in receiving waterbody as defined by the ratio of 'receiving water body catchment area: ASS Priority Area' determined by Tulau and Naylor (1999). A smaller ratio (poor flushing / dilution) is given a higher score in regard to priority due to the potential to have a larger impact on the estuary;
- wetland conservation priorities as described in **Section 4.1.6**. A higher conservation priority is given a higher score in regard to drainage area priority;
- the number of high priority floodgates (as defined by NSW Fisheries, 2002) within each drainage area. The NSW Fisheries report assessed and prioritised 180 floodgates to determine their suitability for active management. Twenty four (24) floodgates were assigned a high priority for active floodgate management. The assessment included consideration of fish habitat value and extent of drains / watercourses and landholder willingness trial active floodgate management. A greater number of 'high priority floodgates' is given a higher score in regard to drainage area priority; and
- Active Drainage Union: a higher score is given to the active drainage unions (Seven Oaks Private Drainage Board and Rafferty Private Drainage Board) due to potential greater ease in implementing projects;
- the number of major floodgates that are not actively managed: a higher score is given to a higher percentage of unmanaged major floodgates due to the potential to introduce active management of floodgates for upstream water level management.

A score out of ten (10) was given for each of the above criteria (10 = high priority, 1 = low priority). A weighting was then applied to the scores based on the importance of each criteria: a higher weighting is given to criteria considered more important or criteria that will have greater impact on estuary health. The weightings are:

- area of ASS hotspot: 15%;
- environmental susceptibility as defined by the ratio of 'receiving water body catchment area : ASS Priority Area': 15%;
- wetland conservation priority: 30%;
- number of high priority floodgates (as defined by NSW Fisheries, 2002): 10%; and
- active drainage union: 10%; and

- number of major floodgates that are not actively managed: 20%.

Application of the above weighting percentages results in an overall score out of 10 (10 = high priority, 0 = low priority). The assessment summarised in **Table 6.2** results in the following order of priorities:

1. Collombatti-Clybucca;
2. Kinchela;
3. Belmore;
4. Frogmore;
5. Yarrahapinni; and
6. Raffertys.

It is noted that aside from the results in **Table 6.2**, the Yarrahapinni wetlands are not considered a priority for future management actions as they are now gazetted a national park and a Restoration Plan for the wetland has been prepared with a Plan of Management currently in preparation. However, the estuary management plan should support the restoration and management plan. It is also noted that drainage management issues of the Swan Pool portion of the Kinchela drainage area are currently being incorporated into the Hat Head National Park Plan of Management. However there remain a significant number of major drains that are unmanaged outside the Swan Pool portion. Therefore, the Kinchela drainage area remains a high priority.

**Table 6.2 Priority Assessment for Floodplain Wetland / Drainage Areas**

| *Issue* | *Score Weighting (%)* | | *Yarrahapinni* | *Collombatti – Clybucca* | *Belmore* | *Frogmore* | *Kinchela* | *Raffertys* |
|---|---|---|---|---|---|---|---|---|
| Area of ASS Hotspot | 15 | Area (ha) | 714 | 2981 | 3510 | 1310 | 2671 | 474 |
| | | Raw Score | 2 | 8 | 10 | 4 | 7 | 1 |
| | | Weighted Score | 0.3 | 1.2 | 1.5 | 0.6 | 1.05 | 0.15 |
| Flushing / dilution factors in receiving waterbody * | 15 | Comment | Very favourable : Macleay River (1640*) | Moderately favourable : Clybucca Creek (8.75*) | Flushing – Moderate; Dilution - Low : Belmore River (2.35*) | Flushing – Moderate; Dilution - Low : Belmore River (3.5*) | Low : Kinchela Creek (2.03*) | Very High : Macleay River (2555*) |
| | | Raw Score | 2 | 6 | 9 | 8 | 10 | 1 |
| | | Weighted Score | 0.3 | 0.9 | 1.35 | 1.2 | 1.5 | 0.15 |
| Wetland conservation priority (WCA / NCEC / Pressey) | 30 | Comment | Very high / Medium high / Not assessed | Medium high / Medium high / Very high | Very high / High / Very high | Not mapped / Medium low / Very high | High / High / Very high | Not mapped / Medium low / Medium |
| | | Score | 9 | 8 | 10 | 5 | 8 | 3 |
| | | Weighted Score | 2.7 | 2.4 | 3.0 | 1.5 | 2.4 | 0.9 |
| No. of priority fish passage drains | 10 | Comment | - | - | 1 | 2 | 7 | 2 |
| | | Raw Score | 7** | 7** | 6 | 7 | 10 | 7 |
| | | Weighted Score | 0.7 | 0.7 | 0.6 | 0.7 | 1.0 | 0.7 |
| Active Drainage | 10 | Comment | - | Yes | No | No | No | Yes |

| *Issue* | *Score Weighting (%)* | | *Yarrahapinni* | *Collombatti – Clybucca* | *Belmore* | *Frogmore* | *Kinchela* | *Raffertys* |
|---|---|---|---|---|---|---|---|---|
| Union | | Raw Score | 10*** | 10 | 5 | 5 | 5 | 10 |
| | | Weighted Score | 1.0 | 1.0 | 0.5 | 0.5 | 0.5 | 1.0 |
| Main Floodgates Actively Managed | 20 | No. Main Floodgates | 1 | 1 | 4 | 2 | 10 | 2 |
| | | Percentage Unmanaged | 0% | 100% | 25% | 50% | 70% | 0% |
| | | Raw Score | 0 | 10 | 2.5 | 5 | 7 | 0 |
| | | Weighted Score | 0 | 2.0 | 0.5 | 1.0 | 1.4 | 0 |
| | | | | | | | | |
| **Total Weighted Score (0 to10)** | | | **5.0** | **8.2** | **7.5** | **5.5** | **7.9** | **2.9** |

Note: * ratio of receiving water body catchment area: ASS Priority Area
** there are no Council-owned drains within Collombatti-Clybucca that were assessed therefore a score similar to the other areas was awarded
*** managed by PWG

## 6.5 Management Objectives

The recognised impacts of the flood mitigation works on estuary health have resulted in the formation of broader objectives for management of the floodgate and drainage system beyond just flood mitigation. However, it is important to remember the original basic aims of the floodgate and drainage system as described by Manly Hydraulics Laboratory (undated):

- to reduce flooding frequency by:
  - increasing stream carrying capacity;
  - floodgating of tributary creeks, rivers and major drains;
  - stabilisation of river banks to retain natural levees and reduce stream scouring;
  - constructing levee banks where natural bank is below required profile;
- to guide overbank flow and thus control floodwaters by;
  - construction of floodways and a control system;
  - use of natural flood storage areas;
  - providing new accesses to the sea;
- to reduce the period of flood inundation by;
  - improving drains; and
  - providing new ocean cuts.

The more contemporary objectives for floodgate and drain management are listed below. These objectives are based on liaison during the EMS phase and objectives developed by the Coast and Estuary Management Committee:

| | |
|---|---|
| ***Management Objective 6/1*** | Coordinate and prioritise projects to ensure consistency of direction; |
| ***Management Objective 6/2*** | Progress initial investigations into water management improvements in the Collombatti-Clybucca drainage scheme; |
| ***Management Objective 6/3*** | Pursue active management of floodgates to achieve best outcomes in non-flood periods; |
| ***Management Objective 6/4*** | Develop a clear floodgate management regime in both flood and non-flood events; |
| ***Management Objective 6/5*** | Manage Yarrahapinni floodgates in accordance with Yarrahapinni Wetlands National Park Plan of Management. |

## 6.6 Management Strategies

### 6.6.1 Coordinate and Prioritise Projects

***Summary:*** Due to the extensive drainage systems in the Macleay estuary and limited resources to address the drainage issues it is important to focus efforts in areas that will achieve greater outcomes for the estuary. To assist in focussing efforts this EMS has prioritised the main drainage catchments for remediation works to improve estuary health (**Section 6.4**). To focus efforts within each drainage catchment it will also be necessary to assess works-to-date and prioritise unmanaged major floodgates.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Adopt prioritised drainage catchments as detailed in **Section 6.4**:<br>1. Collombatti-Clybucca;<br>2. Kinchela;<br>3. Belmore;<br>4. Frogmore;<br>5. Yarrahapinni; and<br>6. Raffertys. | 5/3<br>6/1 | KSC, DECCW, NRCMA |
| Assess works-to-date for prioritised drainage catchments. Assessment to consider cost, effectiveness, landholder satisfaction, environmental improvements and agricultural improvements | 5/3<br>6/1 | KSC |
| Prioritise unmanaged major floodgates for active management. **Table 6.1** lists all the major floodgates and indicates which are currently actively managed. It is recommended the NSW Fisheries spreadsheet of prioritised floodgates (refer to **Section 6.1.3**) is used as the basis for ranking. However it is recommended additional assessment criteria ('degraded catchment area' and 'total maintenance costs') are included in the assessment to maximise the benefit to floodplain wetlands and ASS and ensure cost effectiveness. Prioritisation for Belmore drainage area should also be based on the findings and recommendations of the Upper Belmore Floodplain Management Strategy (2000). | 5/1<br>5/3<br>6/1<br>6/3 | KSC |
| Continue to encourage wetter pasture management in the drainage catchments (described in **Section 4.4**) | 5/2<br>6/1 | KSC, NRCMA |
| Utilise LPMA Digital Elevation Model in future investigations of water management options (refer to **Section 6.1.5**) | 5/3<br>6/1 | KSC, LPMA |
| **Collombatti-Clybucca Drainage Area**: Consider the outcomes of Clybucca Floodplain Wetlands project currently being undertaken by Wetlands Care Australia (refer to **Section 4.1.2.2**). | 5/3<br>6/1 | KSC, NRCMA |

### 6.6.2 Progress Initial Investigations into Water Management Improvements in the Collombatti-Clybucca Drainage Scheme

***Summary:*** Council has initiated preliminary investigations and strategies to improve ecological health and maintain or improve floodwater removal in the Collombatti-Clybucca Drainage Scheme. However lack of detailed contour information has been a factor in preventing progress of the strategies. The strategies include the use of shallower drains for flood mitigation to replace the deeper Seven Oaks Drain and replacing the Clybucca Headworks structure with smaller in-stream works to avoid significant ongoing maintenance costs. Investigations have considered the use of older, abandoned drains. However no detailed modelling has been undertaken to date partly due to a lack of detailed contour information for the area. Council has also installed sluice gates on two of the floodgates of the Clybucca Headworks and developed a management plan for the sluice gates with the intent to provide fish passage through the floodgates and assist in saline neutralisation of acid waters upstream of the headworks. The SOPDB has

not acted on the management plan due to concerns of saline water 'pushing' up the Seven Oaks Drain and potentially killing existing vegetation and leading to salt scalding.

The availability of new Digital Elevation Model (DEM) of the area (refer to Strategy 6.6.5) will enable comprehensive hydrological assessment of potential drainage modifications to the Collombatti-Clybucca Drainage Scheme and assessment of the impact of the sluice gates on salinity in the drainage system. This will require computer modelling of the drainage catchments using the DEM.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Undertake a comprehensive hydrological assessment to determine feasibility for possible improvement to water management in the area to improve ecological health and maintain or improve floodwater removal. LiDAR data will be available to provide more accurate terrain modelling to assist with investigations. The RMA-11 model developed by WMAwater for the region can also be used to assess water quality impacts in the drainage system for any proposed works. | 5/1<br>6/1<br>6/2 | KSC |
| If the Clybucca Headworks are retained following the outcomes of the above investigations pursue implementation of the management plan for the sluice gates installed at the Clybucca Headworks. It has been noted that the SOPDB has not acted on the management plan due to concerns associated with the potential for saline water 'pushing' up the Seven Oaks Drain. If necessary, assess the impact of the sluice gates on salinity in the drainage system by utilising the RMA-11 model developed by WMAwater to address these concerns. | 5/1<br>6/1<br>6/2 | KSC |
| Implement recommended outcomes from the above investigations. | 5/1<br>5/3<br>6/1<br>6/2 | KSC, SOPDB |

### 6.6.3 Actively Managed Floodgates During Non-Flood Periods

***Summary:*** Actively managing floodgates with an opening protocol, floodgate modification or other methods offers the potential to achieve multiple objectives within the drainage catchment. Multiple objectives may include improving drain water quality, enhanced fish passage, maintaining agricultural production and flood mitigation functions. This strategy is aimed developing management plans for the unmanaged major floodgates identified and prioritised in **Strategy 6.6.1**.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Determine the management objectives for the specific floodgate – eg. improve drain water quality, enhance fish passage, maintain agricultural production and flood mitigation function. This will include involvement of landholders in the drainage system and other relevant stakeholders eg. NSW I&I (Fisheries). | 5/1<br>6/1<br>6/3<br>6/4 | KSC |
| Determine the appropriate works to achieve the management objectives for the specific floodgate. This may include: floodgate opening / modification devices for water | 5/1<br>6/1<br>6/3 | KSC |

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| exchange; water retention structures in the drainage system; infilling or shallowing of constructed drains. | 6/4 | |
| Implement works according to priority and available funding | 5/1<br>6/1<br>6/3 | KSC |

### 6.6.4 Clear Management Regime in Flood and Non-Flood Events

***Summary:*** To ensure the flood mitigation objectives of the drainage systems are not compromised, active management of floodgates would be assisted with development of different management regimes to address flood and non-flood periods. The following three management scenarios are proposed:

i. During Floods: as described in **Section 6.1**;
ii. Immediately Post-Flood: as described in **Section 6.1**;
iii. Non-Flood Periods: as described in **Section 6.1**.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Development of floodgate management plans to include the above three management scenarios (During Floods; Immediately Post-Flood; and Non-Flood Periods) | 6/3<br>6/4 | KSC |

### 6.6.5 Manage Yarrahapinni floodgates in accordance with Yarrahapinni Wetlands National Park Plan of Management

***Summary:*** The operation of the Yarrahapinni floodgates is managed by Kempsey Shire Council under an Interim Memorandum of Understanding (MOU). The draft Plan of Management (PoM) for the Yarrahapinni Wetlands National Park requires any change to the operation of the Yarrahapinni tidal floodgates to be undertaken by Kempsey Shire Council, acting in consultation with the Yarrahapinni Headworks Management Advisory Body (called the YHMAB). The Yarrahapinni Headworks Advisory Body consists of representatives from PWG, Kempsey Shire Council and I&I (Fisheries). These representatives are also on the Yarrahapinni Wetlands Working Group.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Any change to the management of the Yarrahapinni floodgates will be done in accordance with the interim MOU, the Yarrahapinni Wetlands Working Group and any further research that supports a change to the floodgates | 5/3<br>6/1<br>6/5 | KSC, PWG, YHMAB, I&I (Fisheries), |

# 7 Boating

## 7.1 Current Status

Recreational boating forms a vital component of the tourism sector of the lower Macleay River Valley and is a significant lifestyle activity enjoyed by a large proportion of its residents. Many of the communities, particularly those in coastal areas, are very much reliant on tourism to drive their local economies.

Availability of suitable river access points and appropriate and complimentary marine infrastructure is critical to the enjoyment of recreation boating in the estuary. The quality of this infrastructure is key to attracting and retaining visitors to the communities along the Macleay River as destinations of choice.

A Marine Infrastructure Assessment (**Appendix A**) was prepared to document and assess the range and quality of marine infrastructure as a basis for determining improved management strategies and possible infrastructure improvements over the long term. The study area included the lower river catchment as far as the tidal limit, some 10 kilometres west of Kempsey.

An important part of this process involved consultation with the boating fraternity and key stakeholders within the local community to identify usage patterns, issues, values and aspirations for change or improvement.

The study identified 18 public boat access points for assessment extending from Greenhill, west of Kempsey, Back Creek near South West Rocks in the east, and Stuarts Point in the upper reaches of the Macleay Arm to the north.

## 7.2 Issues

The outcomes of the site assessment revealed that the quality of boating access and complimentary on-shore support and recreational facilities varied considerably. Many access points have been established on former river punt approaches with little if any further site development. Other locations have been purpose designed and include a full range of infrastructure to cater to high carrying capacities. The assessment revealed that all of the sites required improvements if they were to offer an optimal level of service and facility suitable for their location.

Feedback from the consultation process highlighted significant user concerns along the estuary. Primary issues identified were:

- siltation and weed growth along foreshores preventing optimal water access and navigation at key locations and sections of the river;
- a general lack of adequate, safe launching facilities, particularly for short term mooring;
- a need for improved amenities to enhance riverside locations as a destination for family day use;
- potential to upgrade and expand facilities at particular sites which would off-set major issues associated with peak demand and conflicts between users;
- some concern for conflict between incompatible uses and their proximity to nearby residential areas; and
- conservation and natural values of the estuary which were highly regarded.

## 7.3 Management Objectives

The outcomes of the site assessment and consultation phases were analysed to identify opportunities and constraints for improving boating access and infrastructure. This provided the basis for the following management objectives and guiding principles:

- to ensure the long term sustainability of recreational boating as a key driver of the local economy;
- to provide an equitable distribution and number of launching facilities within the lower Macleay area that reflects the diversity of usage patterns and demands;
- to provide a range of facilities and services that meets the expectations of the boating and wider community and that can be maintained at a high standard within the available resources of the local authority;
- to give contextual consideration to the provision of improved marine infrastructure at particular sites in order to optimise the potential benefits of nearby areas; and
- to ensure the ongoing use and management of marine infrastructure is environmentally sustainable.

A draft strategy was then developed to determine and guide the future implementation of improvements to boating access and infrastructure. This process involved the grouping of sites into the following three categories which reflected a recommended hierarchy of facilities and services that should be developed:

- primary boating and recreation nodes;
- secondary boating and recreation sites; and
- primitive launching sites.

Several sites were also identified where no development was warranted at this stage as they were least favoured for boating or recreational use.

Application of this hierarchy formed the basis of a detailed description of recommendations for each of the investigation sites within the study area. The descriptions included site specific measures that may also be desirable to optimise particular site opportunities.

Following input from a further round of community consultation, the draft strategies will be amended where necessary and developed further as part of the next stage of the project involving the preparation of the Macleay River Estuary Management Plan. This process will involve the identification of strategy priorities, detailed implementation actions, estimated costs, responsibilities, funding sources and timeframes. Concept plans for three key sites will also be generated to demonstrate their design potential through the implementation of the recommended management strategies.

## 7.4 Management Strategies

Adoption of the draft strategy from the Marine Infrastructure Assessment will form the basis of the EMS management strategy for boating.

# 8 Sedimentation and Dredging

## 8.1 Current Status

Sediment movement in the Macleay River estuary is primarily driven by floods. Tidal movements near the river entrance also have a large influence in the marine zone of the estuary (from the Macleay entrance to Jerseyville Bridge and including Macleay Arm). Localised effects on sediment movement in the estuary derive from wind and wave movements, boat wash, dredging, bank training, and land use practices along the banks.

At a catchment scale, the majority of the Macleay River estuary is considered relatively stable in respect to the shape and location of the river. There have not been significant changes over the last 100 years following the creation of the current entrance in 1893 (WMAwater, 2009:65). Estuary bank erosion is not a major contributor to sediment loads in the estuary (WMA, 2009:53).

### 8.1.1 Historical Context

#### *8.1.1.1 Back Creek*

The following notes regarding Back Creek are based on a report produced by Howard (1890), a hydrographical surveyor, reporting on changes that occurred up to 1888 in the Macleay estuary. The notes indicate the issue of the Back Creek entrance intermittently closing (or near closing) in the past.

There were four locations where the Macleay River appears to have broken out to the sea, the most southern one being Back Creek (South West Rocks Creek). Back Creek was connected to the Macleay River at the southern end of Shark Island. In approximately 1868 a 'cutting' was made inside the mouth of Back Creek to allow tidal inflows but the entrance silted up. In 1885 Back Creek was observed to be closed to the ocean. In 1887 a gutter was dug through to the ocean to allow flood waters to drain from the creek. The entrance remained open although it nearly closed on two occasions during 1888. By 1888, two small islands had formed in Back Creek near its confluence with the Macleay River. These nearly blocked the entrance into the creek.

#### *8.1.1.2 Macleay River*

The most significant morphological changes of the Macleay River are associated with the shift in ocean entrance from the southern side of Grassy Head to the present location 1.6 km north of South West Rocks. This occurred in 1893 when a flood of similar magnitude to a 100-year event broke through to the ocean at the present entrance location leaving the old channel (Macleay Arm) to gradually become sediment filled (Telfer, 2005). The new entrance channel was dredged and training walls were constructed by 1897.

The change in the river entrance location has resulted in the Macleay Arm being effectively cut off from the dominating effect of floods on sediment movement. This has resulted in a slow build up of sediment in the Macleay Arm due to windblown sand from the adjoining dunes and progressive infilling from shoals of marine-sourced sands that migrate upstream on the incoming tides (Telfer, 2005).

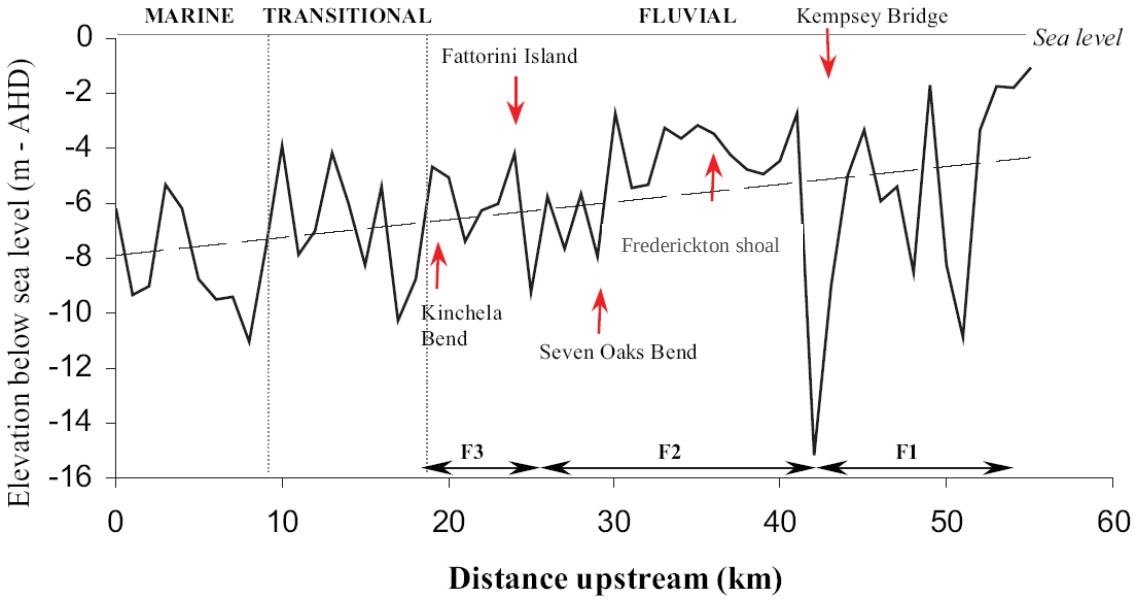
Up until the early 1900s shipping was the 'life blood and mainstay' of communities on the Macleay River estuary. Dredging of selected areas on the Macleay River for navigational purposes has been occurring since the beginning of the 20th century (Kempsey Shire Council, 2008). Early dredging, channel

realignments and channel bed clearing occurred primarily from the 1880s to the 1940s but also continued up to the 1970s (Telfer, 2005).

The middle to upper Macleay River has been vastly transformed since European settlement, resulting in a greatly modified sediment supply regime. The sand and silt eroded from the banks and floodplains of the middle and upper Macleay River (upstream of the study area) throughout the 20th century have been transported into the estuarine reaches and then re-distributed by later floods and tidal processes.

### 8.1.2 Sediment Distribution within the Macleay River

Sediment distribution is described in WMAwater (2009) with reference to the three broad process zones of the river: fluvial; fluvial-marine transitional; and marine flood-tide (Cohen, 2005). A 'snap-shot' of sediment storage patterns in 2003 along these zones is shown in **Illustration 8.1**. The longitudinal profile shown in the illustration is the thalweg (the line defining the lowest points along the length of the river bed). A dashed line of best fit is shown in the profile which indicates areas of net sediment storage (areas above the line of best fit) and scour (areas below the line of best fit).




(Source: Cohen, 2005)

**Illustration 8.1 Longitudinal Profile of the Macleay River from Belgrave Falls to the Entrance**

### 8.1.3 Dredging at Back Creek

Back Creek is experiencing marine sand accretion (sand buildup) at the entrance and within the middle reaches of the system. Back Creek entrance has a current commercial sand dredging operation/licence granted by the Department of Lands (now Land and Property Management Authority - LPMA) in 1995. The licence is commercially based and is undertaken depending on demand for sand. The licence allows for dredging up to 20,000 m³ per annum. However records indicate that annual extraction volumes over the past decade have been in the order of 1,500 to 2,500 m³ with the exception of the financial year of 1999/2000 when extraction volumes increased to 7,500 m³.

The current extraction volumes are not effective for the purpose of maintaining a safe navigable entrance. Estimates indicate 10,000 m³ of sand would need to be initially removed to provide adequate channel depths at the entrance and from the boat ramp to the entrance. Maintenance dredging would then be required to maintain channel depths.

## 8.2 Issues

Sedimentation and associated impacts on boating navigation in certain areas of the river was frequently raised as an issue in the community consultation phase. The main areas of concern are:

- Macleay Arm particularly between Stuarts Point and Fishermans Reach;
- Back Creek entrance and within the creek; and
- to a lesser degree, on the Macleay River in the vicinity of the Riverside Park at Kempsey.

The issues associated with the above areas are described further below. Safety issues associated with crossing the bar entrance of the Macleay River are also described further below.

Other areas of concern noted by the community include Spencers Creek, southern side of Jerseyville, old Frederickton ferry route, and Belmore River.

There were also a number of comments that sedimentation in the river is impacting on flood levels. However this issue has not been confirmed by the Macleay River Estuary Processes Study (WMAwater, 2009).

Sedimentation issues highlighted by the Coast and Estuary Management Committee include:

- the Macleay River, Macleay Arm and Clybucca Creek appear to be getting shallower over time; and
- the entrance to Back Creek is constantly shallow, regardless of the amount of current dredging.

### 8.2.1 Back Creek

Back Creek is used for both professional and recreational boating. Under adverse weather conditions, navigation of the entrance is difficult. The basic problems to the navigation of Back Creek entrance are:

- the shallow depth over the bar;
- the channel alignment, which at times require boats to approach abeam (at right angles) to the seas.

The advantages offered by Back Creek entrance are:

- it is well protected against the prevailing South Easterly weather conditions;
- the width of the bar is small and can be traversed reasonably rapidly; and
- closer proximity to South West Rocks compared to Mattys Flat.

The boat launching area in Back Creek is located approximately 1 km from the mouth of Back Creek. Its primary use is for launching boats that are heading for oceanic waters. To maintain acceptable levels of navigability, the channel would have to be 20 m wide and 2 m deep at low water (R. McDonagh, *pers. comm.* cited in Letcher *et. al.*, 2007).

Investigations by Foster (1990) indicate there is insufficient tidal flow to maintain adequate channel depths following initial dredging even with the implementation of measures to connect Back Creek to Macleay River. Therefore any dredging of the entrance channel would require maintenance dredging to maintain adequate channel depths. There are no accurate estimates of the annual extraction volume required to maintain navigability. To facilitate effective maintenance dredging of the entrance the Foster report recommends extension of the eastern training wall by 50 to 75 m to enable land-based extraction to access the entire bar. Extension of the wall could be staged.

A sustainability assessment report on entrance management strategies at Back Creek (Letcher, *et. al*., 2007) which is based on results from the Coastal Lake Assessment and Management (CLAM) tool indicates that:

- increasing the rate of drag lining (dredging) is expected to lead to a large increase in flushing time in the upper creek, channel and at the entrance while dredging a channel between the training walls and the boat ramp would be expected to lead to a moderate increase;
- dredging a channel or increasing the rate of drag lining can be expected to lead to declining water quality in all parts of the creek; and
- many ecological parameters are unaffected but both increasing the rate of drag lining and dredging a channel can be expected to lead to decreases in the extent of seagrasses and aquatic fauna.

### 8.2.2 Macleay Arm

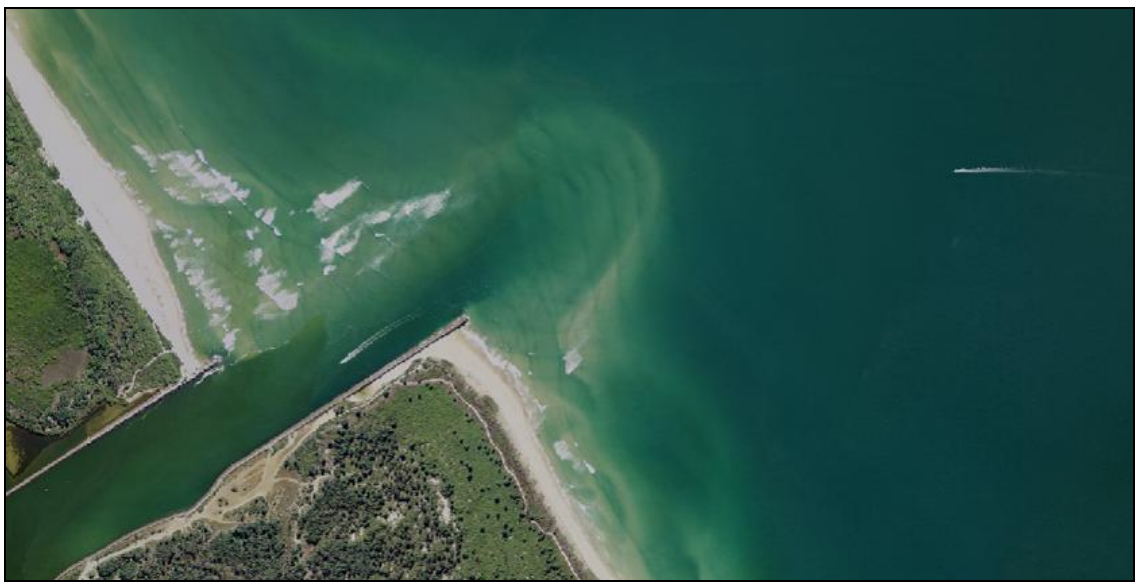
Marine sand accretion has occurred in the Macleay Arm following the change in river entrance location in 1893. Navigation is restricted to a defined channel. Community concerns have been expressed in regard to improving the navigability of the Macleay Arm area between Stuarts Point and Fishermans Reach by increasing the depths in the boating channel.

### 8.2.3 Riverside Park Boat Ramp - Kempsey

The Riverside Park boat ramp is the primary designated boat ramp located in Kempsey for recreational boat launching. At the ramp there is a large amount of sediment that makes it difficult for recreational boats to launch and retrieve.

### 8.2.4 Macleay River Entrance

Safety concerns have been raised by recreational and commercial boat users regarding crossing the bar entrance of the Macleay River. An environmental assessment was conducted in 1994 (Sinclair Knight Merz Pty Ltd, 1994) on the environmental impacts associated with the proposed trial of maintenance dredging at the Macleay River entrance. The purpose of dredging at the entrance was to alleviate the difficult navigation conditions that had resulted from shoaling. It is understood the trial dredging did not proceed for reasons unknown. The environmental assessment concluded the proposed dredging would not have the potential to significantly affect the environment. The assessment found there was potential for some short term environmental impacts: noise, water quality impacts, visual and impacts on navigation within the river. The report noted that the proposed dredging operations could only be considered a relatively short term solution to the navigational issues due to the dynamic nature of the river entrance which results in the continual formation and movement of bars and minor shoals (Sinclair Knight Merz Pty Ltd, 1994:6-1).



Source: LPMA (date of aerial photography: 2009)

**Plate 8.1 Macleay River Entrance**

## 8.3 Management Objectives

The estuary management study objectives for sedimentation and dredging are:

| | |
|---|---|
| ***Management Objective 8/1*** | Develop a protocol to address boating navigation concerns associated with sedimentation at Back Creek entrance including sedimentation between the Back Creek boat launching facilities and the entrance; |
| ***Management Objective 8/2*** | Develop a protocol to address boating navigation concerns associated with sedimentation in Macleay Arm (between Stuarts Point and Fishermans Reach) and at Riverside Park at Kempsey; and |
| ***Management Objective 8/3*** | Investigate measures to improve community understanding of safety issues associated with crossing entrance bars, in the context of prevailing coastal processes. |

## 8.4 Management Strategies

### 8.4.1 Develop an Entrance Management Protocol for Back Creek

***Summary:*** Provision of a navigable channel and entrance at Back Creek to provide ocean access for small boats has been raised by the community as a desirable outcome of the estuary management program. Improving ocean access at Back Creek will take some pressure off the boat launching facilities at Mattys Flat and will generally provide a safer ocean access option for smaller boats (in comparison to the Macleay River entrance). However, due to the uncertainties associated with dredging requirements for Back Creek and significant ongoing costs associated with maintenance dredging, it is recommended that in the first instance an Entrance Management Protocol is developed. The protocol will address navigation at Back Creek entrance and include sedimentation within the creek to address issues of navigating from the boat launching facilities to the entrance. The purpose of the protocol is to:

- Acknowledge the natural processes specific to Back Creek;
- Acknowledge that entrance conditions can affect the estuary water quality, ecology and recreational amenity of the creek and that intervention at times may be warranted under agreed protocols;
- Describe the main legislative framework governing the ability for local authorities to intervene in the entrance conditions of Back Creek and to dredge between the boat launching facilities and the entrance; and
- Document the protocols for Entrance Management that determines whether intervention is required.

| ***Steps Required*** | ***Objectives Addressed*** | ***Key Responsibilities*** |
|---|---|---|
| Prepare an Entrance Management Protocol | 8/1 | KSC, NSW Maritime, LPMA |
| Prepare a Review of Environmental Factors (REF) for maintenance dredging for submission and registration with NSW I&I (Fisheries) | 8/1 | KSC, NSW Maritime |
| Adopt and Implement Entrance Management Protocol | 8/1 | KSC |

### 8.4.2 Develop a Maintenance Dredging Protocol for Macleay Arm and Riverside Park at Kempsey

***Summary:*** Navigation issues associated with sediment accretion in the Macleay Arm between Stuarts Point and Fishermans Reach and near the Riverside Park boat ramp at Kempsey has been raised by the community during the consultation phase of the estuary management study. Due to the uncertainties associated with dredging at these locations and significant ongoing costs associated with maintenance dredging, it is recommended that in the first instance a Maintenance Dredging Protocol is developed for these areas. The purpose of the protocol is to:

- Acknowledge the natural processes specific to these locations;
- Acknowledge that shoaling can affect navigability at these locations and that intervention at times may be warranted under agreed protocols;
- Describe the main legislative framework governing the ability for local authorities to undertake maintenance dredging; and
- Document the protocols for maintenance dredging that determines whether dredging is required.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Prepare a Maintenance Dredging Protocol | 8/2 | KSC, NSW Maritime |
| Prepare a Review of Environmental Factors (REF) for maintenance dredging for submission and registration with NSW I&I (Fisheries) | 8/2 | KSC, NSW Maritime |
| Adopt and Implement Maintenance Dredging Protocol | 8/2 | KSC |

### 8.4.3 Improve Community Understanding of Safety Issues of Crossing Entrance Bars

***Summary:*** Safety concerns have been raised by recreational and commercial boat users regarding crossing the bar entrance of the Macleay River. Dredging has been considered in the past to address this issue however this is not considered a long term solution due to the dynamic nature of the river entrance which results in the continual formation and movement of bars and minor shoals (Sinclair Knight Merz Pty Ltd, 1994:6-1). Improved awareness of the safety issues associated with crossing entrance bars in the context of prevailing coastal processes will assist in managing this issue.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Review existing safety information and access to information | 8/3 | NSW Maritime |
| Assess need for updates to existing safety information and strategy for disseminating information | 8/3 | NSW Maritime |
| Revise safety information where necessary and disseminate according to strategy | 8/3 | NSW Maritime |

# 9 Tourism

## 9.1 Current Status

Tourism is a significant regional industry with the Macleay area attracting approximately 415,000 visitors per year spending an average total of $90 million (Kempsey Shire Council, *pers. comm*. cited in WMAwater, 2009).

The community consultation undertaken as part of this EMS included a general survey and boating survey. The surveys provided the following statistics in regard to visitors and tourism:

- approximately 9% of the survey respondents were from outside the Kempsey local government area and 2% were from outside the Mid-North Coast area;
- recreational fishing, picnicking, walking, and swimming were the most significant activities or uses of the river for the respondents; and
- recreational fishing, recreational boating and paddling were the most significant boating activities on the river for the respondents.

### 9.1.1 Macleay Valley Coast Tourism Strategic Plan

The Macleay Valley Coast (MVC) Tourism Strategic Plan, 2005 to 2009, was prepared by Kempsey Shire Council, Tourism NSW, National Parks and Wildlife Service and the NSW Department of State and Regional Development. The strategic plan states '*tourism and recreation use of the Macleay River is limited. River access infrastructure is currently not configured to promote river-based recreation and tourism experiences and the townships of the MVC have lost their historic physical and symbolic connection with the river*'.

The Strategic Plan details a five-year plan that proposed to:

- create a hub and spoke network that connects the region's coastal and hinterland tourism townships via an experiential network; and
- create thematic districts in the Region that create experiential diversity and encourage regional exploration and travel.

Some of the more specific strategies relevant to the EMS included:

- a holistic management approach is proposed across all coastal protected areas to more effectively focus resources towards important protected area management objectives and generate enhanced revenues that can be re-directed back into enhanced protected area management efforts in these locations. Measures proposed within the Plan include the rationalisation of walking trails in the protected areas;
- enhanced river access and marine access infrastructure is to be developed and linked with the MVC tourism network to promote river recreation and tourism opportunities as part of the MVC tourism experience;
- assess the potential for a regional gallery, outdoor performing arts venue, riverine boardwalk and riverside event area adjacent to the Macleay River in Central Kempsey; and
- the history of use between the Macleay River and the local townships of Stuarts Point, South West Rocks, Gladstone, Kempsey, Frederickton and Bellbrook has been lost as river transport use has subsided over the last 50 years and river recreation and tourism use is virtually non-existent. A

number of heritage precinct planning measures are proposed in the Plan that pay tribute to the river's integral connection with the community and reinstate its traditional role of the river as an important economic, recreational and tourism asset for the shire. These are addressed further in **Section 15** of this EMS.

In respect to the strategy of rationalising walking trails in the protected areas, National Parks is currently undertaking a scheme to train indigenous cultural guides for interpretive guides / talks for the Clybucca Historic Site which adjoins Yarrahapinni wetlands.

## 9.2 Issues

Tourism management issues noted in the Brief for this EMS include:

- increased population and recreational pressures and demands/impacts on habitat;
- increased demand for facilities;
- lack of toilet facilities particularly at Fishermans Reach and Back Creek;
- boat ramp facilities and public access along Macleay River estuary are generally of a poor standard;
- lack of boat washing facilities; and
- primitive camp site impacts e.g. on Renwick Island, Golden Hole and Fisherman Reach areas.

The issues regarding boating facilities have been addressed as part of the Marine Infrastructure Assessment (GeoLINK, 2010) which is summarised in **Section 7**.

## 9.3 Management Objectives

The broad tourism management objectives are:

- provision of a range of suitably located public access reserves with well designed facilities along the waterway foreshores;
- 'reconnection' of the Macleay Valley townships with the river. This can be facilitated by providing more opportunities for pedestrian access to the river, providing better visual connection between the townships and the river, and ensuring new public riverfront development is designed to maximise the visual connection and physical connection (via pedestrian access) to the river.

Specific CEMC objectives for this EMS are to identify opportunities for provision of recreational facilities such as walkways and cycle paths, in addition to the associated objectives relating to water quality, boating use, habitat protection and sedimentation. Tourism strategies relating to boating are addressed in **Section 7**.

The EMS consultation process indicated some community desire for a foreshore walkway in the Macleay Arm area between Stuarts Point and the Golden Hole Picnic Area (at the southern end of Lindsays Trail near the outlet from Yarrahapinni Wetlands to Andersons Inlet). Unauthorised tracks exist in parts of this area. The Plan of Management being developed for Yarrahapinni Wetlands National Park considers bushwalking through the park, bush camping, and encouragement of ecotourism opportunities when the wetlands are rehabilitated. Existing pedestrian access along the old levee wall near Golden Hole Picnic Area may be removed in sections with the removal of the levee wall to allow water to inundate the wetlands. PWG are considering constructing a series of low level footbridges to re-establish pedestrian access in the location of the levee wall to the south-west of the park from Golden Hole Picnic Area. Based on the above the following objective has been developed:

| | |
|---|---|
| ***Management Objective 9/1*** | Maximise opportunities for public access to the Macleay River from commercial areas and the public domain within riverside townships (eg. Kempsey CBD, Frederickton, Smithtown, Gladstone, Kinchela, Stuarts Point, and South West Rocks); |
| ***Management Objective 9/2*** | Reconnect the built form and public domain of riverside townships with the Macleay River; |
| ***Management Objective 9/3*** | Future pedestrian / cycle paths in the Macleay Arm area. |

## 9.4 Management Strategies

### 9.4.1 Investigate appropriate strategies to reconnect riverside townships with the Macleay River

***Summary:*** The historical and strong relationship between the Macleay River and riverside townships has been lost as river transport use has subsided over the last 50 years. River recreation and tourism use is limited with the exceptions of boating and fishing. Riverside urban development frequently 'turns it's back' on the river and restricts public access and visual connection between town centres and the river. Reconnecting riverside townships with the Macleay River can be assisted by maximizing opportunities for public access to the river, enhancing riverside areas of the public domain, providing visual connection between town centres and the river, and guiding the built form of riverside development to achieve an active interface and connection between between the internal space of the buildings and the river.

| ***Steps Required*** | ***Objectives Addressed*** | ***Key Responsibilities*** |
|---|---|---|
| Investigate appropriate strategies to maximise opportunities for public access to the river, enhancing riverside areas of the public domain, providing visual connection between town centres and the river, and guiding the built form of riverside development | 9/1<br>9/2 | KSC |

### 9.4.2 Ensure recreation pedestrian / cycle paths in the Macleay Arm area are developed to complement the objectives of the Clybucca Historic Site and Yarrahapinni Wetlands National Park

***Summary:*** The distance from Stuarts Point to Fishermans Reach is approximately 4 km and then a further 4km from Fishermans Reach to Golden Hole Picnic Area – a significant distance in respect to developing a formalized pedestrian or cycle path for a relatively small demand. Vehicle access from Stuarts Point to Golden Hole Picnic Area is along Fishermans Reach Road and Lindsays Trail at the southern extent. The road from Fishermans Reach to Golden Hole Picnic Area is located near the foreshore. Some unauthorized tracks / paths also exist adjacent to the foreshore in this section. The foreshore vegetation / landform (tidal marsh wetlands) between Stuarts Point and Fishermans Reach are not conducive to easy development of a foreshore path. In view of the significant expense and relatively low demand for a foreshore walkway, it is recommended that future recreation pedestrian / cycle paths in the Macleay Arm area are developed if demand increases in response to the development and rehabilitation of the Yarrahapinni Wetlands National Park and in response to promotion of ecotourism associated with the Clybucca Historic Site and Yarrahapinni Wetlands National Park.

| ***Steps Required*** | ***Objectives Addressed*** | ***Key Responsibilities*** |
|---|---|---|

| | | |
|---|---|---|
| Future consideration of recreational pedestrian / cycle paths in the Macleay Arm area involve discussions between Kempsey Shire Council and Parks and Wildlife Group to complement the proposed public use and education strategies of the Clybucca Historic Site and Yarrahapinni Wetlands National Park | 9/3 | KSC, PWG |

# Habitat Protection

## 10.1 Current Status

The Macleay estuary and floodplain supports a diverse range of aquatic, estuarine and terrestrial habitats (GeoLINK 2009). Birch and GeoLINK (2010) provide an overview of ecological values of the MREMP study area floodplain and estuary from available relevant studies and databases. That report also outlines further investigations undertaken to identify key habitat areas for threatened species and Endangered Ecological Communities (EECs). The findings are summarised below.

### 10.1.1 Significant Fauna Habitat

Forty-one threatened fauna species listed under the *Threatened Species Conservation Act 1995* (TSC Act) and/or *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), have been recorded on the MREMP study area estuary and floodplain (Birch and GeoLINK 2010). Records of 26 EPBC Act listed migratory species (excluding marine species) indicate known occurrences on or adjacent to MREMP floodplain study area. Key potential habitat types for locally recorded threatened fauna included:

- Dry Sclerophyll Forest;
- Wet Sclerophyll Forest;
- Swamp Sclerophyll Forest;
- Coastal Scrub/Heath;
- Rainforest;
- Estuarine;
- Wetland (Freshwater);
- Estuary; and
- Water surfaces.

These areas are shown in **Illustration 10.1**, however further investigations were considered necessary to prioritise areas for conservation management purposes.

The *Comprehensive Koala Plan of Management for Eastern Portion of Kempsey Shire LGA (Draft) Volume 1* and *2* (Phillips and Hopkins 2009a, 2009b) was reviewed and identified to encompass the MREMP study area floodplain. Potential Koala habitat mapping results relevant to the MREMP study area floodplain is shown in **Illustration 10.2**. The study area is mapped (in descending order):

- **Unknown** – defined as areas for which insufficient information regarding community composition was available;
- **Other** - defined as communities within which Koala food trees were absent;
- **Secondary (Class A)** – defined as primary food tree species present but not dominant or co-dominant and usually (but not always) growing in association with one or more secondary food tree species;
- **Secondary (Class B)** – defined as habitat comprising secondary and supplementary food tree species only, but with primary food tree species being absent and
- **Primary** – defined as areas of forest and/or woodland wherein primary food tree species comprise the dominant or co-dominant (i.e. ≥ 50%) overstorey tree species).

Koala Management Areas (KMAs) were also identified by in Figure 6.1 of Phillips and Hopkins (2009b), as follows:

- Eungai Rail – Stuarts Point – Grassy Head KMA;
- South West Rocks KMA; and
- Dongdingalong – Kundabung – Crescent Head KMA.

All KMAs overlap small areas of the MREMP study area floodplain (refer to **Illustration 10.2**).

The draft *Shorebird Data Audit – Northern New South Wales* (Sandpiper Ecological Surveys 2009) was undertaken to provide a baseline dataset that can be used for planning and management within the Northern Rivers Catchment Management Authority (NRCMA) region, which includes the Macleay estuary.

The shorebird data audit (Sandpiper Ecological Surveys 2009) found that only two shorebird surveys had been undertaken in the Macleay Estuary. This and the fact that both surveys were undertaken in consecutive years at high tide (hence not accounting for tidal influences on species distribution and abundance), places some doubt in the accuracy of shorebird population estimates and species diversity in the Macleay Estuary. A total of 14 migratory shore bird species and five resident shorebird species were recorded in the Macleay Estuary, four of which are listed as threatened.

Sandpiper Ecological Surveys (2009) found that comparison of maximum and average migration period population estimates illustrates the importance of major estuaries to the diversity and abundance of shorebirds in northern NSW. The five large estuaries in the study area (which includes the Macleay estuary) provide the habitat for the majority of the shorebird population in the northern rivers region.

Sandpiper Ecological Surveys (2009) identifies and prioritises 33 recommendations for the management of shorebirds in the NRCMA. Those relevant to the Macleay EMP are discussed further in **Section 12**.

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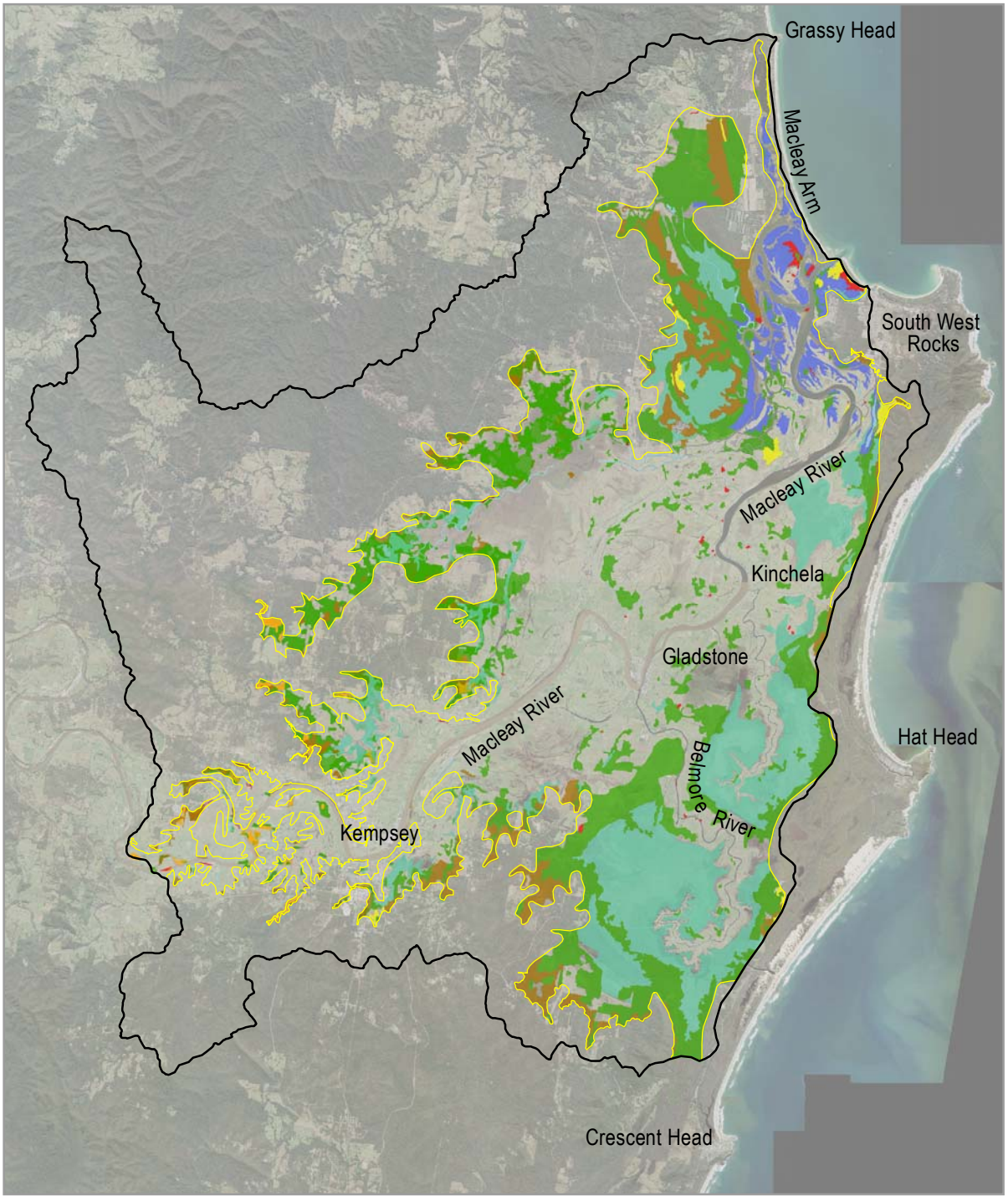



LEGEND

- Study area
- MREMP floodplain study area
- Coastal Scrub/Heath
- Dry Sclerophyll Forest
- Estuarine
- Rainforest
- Swamp Sclerophyll Forest
- Water surfaces
- Wet Sclerophyll Forest
- Wetland (Freshwater)

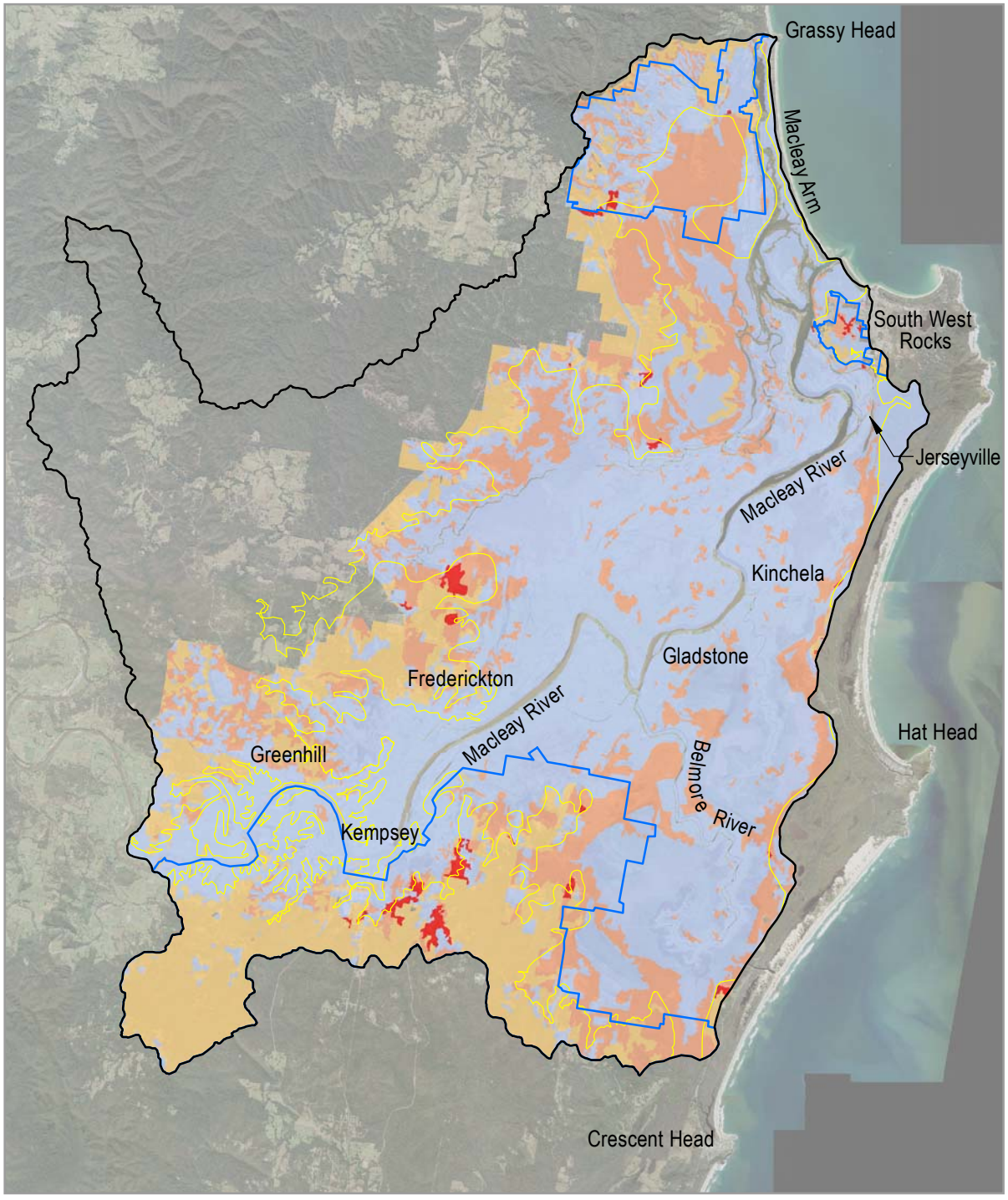
0 5 km

North

**Key Threatened Fauna Habitat Types within the MREMP Study Area Floodplain**

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*




LEGEND

- Study area
- MREMP floodplain study area
- Draft CKPoM Koala Habitat Mapping and Koala Management Areas
- Primary
- Secondary (Class A)
- Secondary (Class B)
- Predominantly cleared / partially cleared

0 5 km

North

**Draft CKPoM Koala Habitat Mapping and Koala Management Areas**

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352727

Illustration 10.2

### 10.1.2 Significant Flora Habitat

Birch and GeoLINK (2010) identified records of six threatened flora species listed under the TSC Act or EPBC Act within the MREMP study area floodplain. Key potential habitat types for locally recorded threatened flora included:

- Dry Sclerophyll Forest;
- Wet Sclerophyll Forest;
- Swamp Sclerophyll Forest;
- Coastal Scrub/Heath;
- Rainforest;
- Wetland (Freshwater); and
- Areas along watercourses.

These areas are shown in **Illustration 10.3**, however further investigations were considered necessary to prioritise areas for conservation management purposes.

### 10.1.3 Significant Aquatic Habitat

Under Part 7 of the *Fisheries Management Act 1994* all marine vegetation in public water land or the foreshores of public water land is protected from harm. On the Macleay River estuary this primarily refers to mangroves, saltmarsh (a recent addition to legislation) and seagrass habitats but also includes the small areas of macroalgae that are found along the breakwalls and rock revetment works in the lower estuary.

Seagrass, saltmarsh and mangroves are important habitats for a number of reasons. They have a demonstrated nursery function and have been shown to be important in the life cycles of many commercially targeted species. They provide cover for a wide range of species and are responsible for a significant proportion of the total primary production of the estuary.

A recent assessment showed that the detected distributions of mangroves, seagrass and saltmarsh in the Manning Shelf Bioregion all increased between 1981 and 2004 (Williams *et al*. 2006). Two results of two surveys mapping vegetative habitats in estuaries, West (1985) and CCA (2006), were compared. The two surveys compared had different methods at their disposal. The later survey was able to detect habitats at a greater resolution and therefore the detected changes may not infer an actual increase in the area of vegetative habitats. The same survey, applied to the Macleay River and South West Rocks (Back) Creek showed increases in the cover of mangroves and saltmarsh system wide and a decrease in the cover of seagrass system wide. The results of the survey are summarised in **Table 10.1.**

**Table 10.1 Detected cover of vegetative estuarine habitats from West (1985) and CCA (2006)**

| *Habitat* | *System* | *West (1985) Calculated Area (ha)* | *CCA 2006 Calculated Area (ha)* | *Apparent Percentage Change in Area* |
|---|---|---|---|---|
| Mangrove | Macleay R | 520.1 | 566.5 | + 8.9 |
| | SWR Ck | 52.8 | 69.3 | + 31.3 |
| Saltmarsh | Macleay R | 365.2 | 421.3 | + 15.4 |
| | SWR Ck | 14.1 | 14.7 | + 4.3 |
| Seagrass | Macleay R | 109.7 | 95.7 | - 12.8 |
| | SWR Ck | 2.4 | 0.2 | - 91.7 |

The distribution of seagrasses in the Macleay is likely to be primarily effected by sedimentary processes and light availability. Sedimentary processes can affect sea grass distribution in two basic ways;

- Sediment infill of deep holes can increase the available substrate for colonisation by seagrasses. The opposite is also true for scouring of deep holes; and
- The deposition of large volumes of sediment over a short time can smother seagrasses and eliminate populations.

Light availability, generally controlled by the concentration of suspended solids and/or microalgae in the water column, affects the growth rate and depth range of sea grasses. A reduced growth rate can make sea grasses susceptible to fouling (epiphytic) algae. Other processes that may be leading to a reduction in the total area of seagrass include propeller and anchor damage or other types of physical damage.

Middleton (1985) analysed changes in the distribution of mangroves in the lower Macleay River between 1956 and 1981 by dividing the estuary up into zones. Birch and GeoLINK (2010), following the methods of Middleton (1985) and using the CCA (2006) estuarine habitats mapping layer further assessed changes in the distribution of mangroves across the system. The results reported by Middleton (1985) showed reduction of 35% across the estuary with major losses from the Yarrahapinni zone and the Clybucca Creek zone. The results from Birch and GeoLINK (2010) suggest that the cover of mangroves has increased slightly across the system since 1981 with major changes in the distribution around Pelican Island and Stuarts Point. Again, these figures may be misleading due to the improved resolution of the CCA (2006) estuarine macrophytes mapping. The results are summarised in **Table 10.2**.

**Table 10.2 Changes in the Distribution of Mangroves in the Macleay Floodplain**

| | *1956* | | *1981* | | *2004* | |
|---|---|---|---|---|---|---|
| ***Zone*** | ***Area (ha)*** | ***% total*** | ***Area (ha)*** | ***%change*** | ***Area*** | ***%change*** |
| Stuarts Pt | 100 | 12 | 100 | 0 | 115 | +15 |
| Shark Is | 180 | 22 | 190 | +5 | 192 | +1 |
| Pelican Is | 90 | 11 | 80 | -10 | 99 | +24 |
| Yarrahapinni | 200 | 24 | 0 | -100 | 0 | 0 |
| Clybucca Ck | 260 | 31 | 160 | -40 | 161 | +1 |
| Total | 830 | 100 | 530 | -35 | 567 | +7 |

Saltmarsh is distributed throughout the lower Macleay though the majority (>60%) occurs as extensive fields of marine rush and salt couch in the Clybucca Creek / Andersons Inlet area. The majority (>80%) of the seagrass in the Macleay is found in the Macleay Arm between Shark Island and Grassy Head. Very little seagrass is found in Clybucca Creek or the main channel of the Macleay Arm. No seagrass is found in Spencers Creek where anecdotal evidence suggests there was formerly a large and healthy population. The distribution of seagrass and saltmarsh through the Middleton (1985) zones, using the mapping produced by CCA (2006) is summarised in **Table 10.3**. The cover of mangroves in South West Rocks Creek is also included in the table.

**Table 10.3 The distribution of seagrass and mangroves in the Middleton (1985) zones according to the CCA (2006) estuarine macrophytes mapping**

| *Zone* | *Area of saltmarsh (ha)* | *% total* | *Area of seagrass (ha)* | *% total* |
|---|---|---|---|---|
| Clybucca | 267.9 | 61% | 5.6 | 6% |
| Pelican Island | 32.1 | 7% | 7.2 | 8% |
| Shark Island | 83.3 | 19% | 21.9 | 23% |
| Stuarts Pt | 20.9 | 5% | 61.1 | 64% |
| Yarrahapinni | 18.5 | 4% | 0.0 | 0% |
| SWR Ck | 13.2 | 3% | 0.2 | 0% |
| **Total** | **435.9** | | **96.0** | |

### 10.1.4 Endangered Ecological Communities

The following TSC Act listed EECs with known occurrences within the MREMP study area floodplain (Birch and GeoLINK 2010):

- Freshwater Wetlands on Coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (hereon in referred to as Freshwater Wetlands);
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions (henceforth referred to as Coastal Saltmarsh);
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (henceforth referred to as Swamp Sclerophyll Forest);
- Swamp Oak Floodplain Forest of the NSW North Coast North Coast, Sydney Basin and South East Corner bioregions (henceforth referred to as Swamp Oak Floodplain Forest);
- Subtropical Coastal Floodplain Forest of the NSW North Coast Bioregion (henceforth referred to as Subtropical Coastal Floodplain Forest);
- Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner bioregions (henceforth referred to as Littoral Rainforest);
- Lowland Rainforest in NSW North Coast and Sydney Basin bioregion (henceforth referred to as Lowland Rainforest); and
- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (henceforth referred to as River-Flat Eucalypt Forest).

In undertaking field sampling at 35 sites nominated as candidate EEC's, Birch and GeoLINK (2010) undertook a review and assessment of the previous candidate EEC mapping undertaken across the majority of the MREMP study area floodplain by Telfer and Kendall (2006). The results of this assessment indicated that on a broad landscape level, the Telfer and Kendall (2006) mapping was useful for identifying areas constituting EECs, however the use of the mapping for site specific identification of particular EECs was not always reliable.

Anecdotal observations made of the floodplain during the field survey identified small areas with floristic attributes consistent to those of the floodplain EECs (e.g. Freshwater Wetlands), though not mapped on the Telfer and Kendall (2006) mapping. However it is acknowledged that due to the scale of the mapping, smaller units (<0.5 hectares), were not included. Hence it is important for Council, land owners and other relevant stakeholders to be aware that other areas on the floodplain may still constitute an EEC.

An associated condition assessment comparison between the field sampling results and the Telfer and Kendall (2006) vegetation condition assessment identified that the Telfer and Kendall (2006) mapping was considered to provide a reasonable guide for the state of the EECs within the study area at a broad landscape scale. It may therefore provide a tool to assist in the development of management measures at

a broad landscape scale. Further investigations are however considered necessary for identifying vegetation condition and associated management implications at a site specific level.

The EPBC Act listed EEC Littoral Rainforest and Coastal Vine Thickets of Eastern Australia as potentially occurring within the MREMP floodplain study area. In areas currently known to constitute Lowland Rainforest or Littoral Rainforest however, further investigations would be required to determine the actual local occurrence of this community. No other EPBC Act 1999 EEC was considered as potentially occurring within the study area.

Birch and GeoLINK (2010) identified that on a broad landscape scale, areas within the MREMP floodplain study area are considered of high conservation value as the vegetation is considered known or likely to constitute TSC Act 1995 listed EECs (**Illustration 10.4**, **10.5** and **10.6**):

- The Telfer and Kendall (2006) mapped Candidate EECs;
- SEPP 14 – Coastal Wetlands;
- SEPP 26 – Littoral Rainforest;
- ID Landscape Management (2005) as "*floodplain rainforest pockets*"; and
- the "Potential EEC B Region" GIS layer provided by KSC.

Further investigations would be required to identify priority sites for conservation management purposes.

### 10.1.5 Corridors

Birch and GeoLINK (2010) undertook a review of the habitat corridors associated with the MREMP study area floodplain. This included:

- ***DECCW Key Habitats and Regional Corridors***. In total parts of 12 different regional corridors and one subregional corridor overlap the floodplain (refer to **Illustration 10.7**);
- ***DECCW Climate Change Corridors***. The DECCW undertook a strategic mapping program to help identify land for conservation efforts to assist adaptation to the potential adverse effects of climate change (DECC 2009). This included:
  - two Coastal Complex Corridors that cover a substantial portion of the MREMP study area floodplain (refer to **Illustration 10.8**);
  - two Dry Forest Corridors that overlap small areas of the MREMP study area floodplain in the far north and south (refer to **Illustration 10.9**);
  - a Moist Forest Corridor that overlaps relatively small areas on the northern fringes of the MREMP study area floodplain (refer to **Illustration 10.10**); and
- ***Riparian Corridor***. The riparian corridor (a minimum of 100m in width from the Macleay Estuary) provides a significant local corridor (refer to **Illustration 10.11**). Due to the current fragmented and limited extent of habitats within this area, its current function would be as a "stepping stone corridor" for predominantly high mobility species moving along the riparian corridor, or when moving north-south across the floodplain.

Birch and GeoLINK (2010) suggested that while a broad range of species may be able to utilise the habitats on a local scale that are overlapped by the subject corridors, regional movements for species with limited mobility (e.g. Common Planigale, Wallum Froglet, etc) would be restricted by the occurrence of the Macleay Estuary and other potential barriers (e.g. local roads, pastoral areas, etc). Hence this corridor is typically expected to support the regional and sub-regional movements of more mobile species (e.g. birds, Flying-foxes, Gliders, etc).

Collectively, the above corridors overlay a mosaic of habitat areas and disturbed land, particularly pastoral areas. Establishing a network of local corridors between existing habitat areas within the broader regional and sub-regional corridors should be undertaken to help maintain and improve the functional values of

corridors. In order to identify realistic inter regional/subregional corridors, further investigations would be required to:

- review GIS layers of high conservation value habitat within the footprint of the identified regional/subregional corridors and prioritise sites;
- liaise with relevant landowners and stakeholder to:
  - explore opportunities to protect and maintain existing priority habitats;
  - identify opportunities to improve connectivity between key habitat areas (e.g. explore options for creating stepping stone or linear linkages, explore potential options that provide dual land use benefits (e.g. vegetation screens and windbreaks); and
  - investigate establishment and protection opportunities of the interlinking corridor features.

### 10.1.6 Candidate Marine Protected Areas

Birch and GeoLINK (2010) investigated the potential for candidate Marine Protected Areas (MPA's) in the Macleay River estuary with the goals to:

- conserve, where possible, unique biological or physical features of the system;
- provide an area for the conservation of key features of the estuary;
- provide a refuge for fish and invertebrates from fishing pressures; and
- provide an area for education and a research.

Birch and GeoLINK (2010) recommended the most suitable location for a candidate MPA is within the boundaries of the Yarrahapinni Wetlands National Park. The following justifications are considered relevant:

- Though the wetlands are in a dynamic state of recovery and there is little seagrass or mangrove habitat within its waters, the Yarrahapinni candidate MPA scored second most highly in the ranking exercise applied;
- The wetlands were once home to very large areas of mangroves, seagrass and saltmarsh and with the reintroduction of tidal flows are likely to be so once again;
- The current barriers to access and fishing closures make it a practical choice, as the commercial and recreational fishing communities will not be 'losing' areas currently regarded as productive fishing grounds and access for most motorised craft is impossible;

The combination of a fishing closure (all methods illegal, all the time) in the waters upstream of the floodgates and the bund wall levee and access restrictions due to the floodgates and levee mean that the Yarrahapinni Wetlands National Park acts as a *de facto* MPA, most similar to an aquatic reserve in nature. The high ranking of the Yarrahapinni area as a suitable location for a candidate MPA (Birch and GeoLINK, 2010), the potential acceptance of it as an Aquatic Reserve to the general public and stakeholders and the existing barriers to access may make it ideal as a formalised Aquatic Reserve for the Macleay River estuary system. Further investigation of this issue is recommended in the management strategies in **Section 10.4**.

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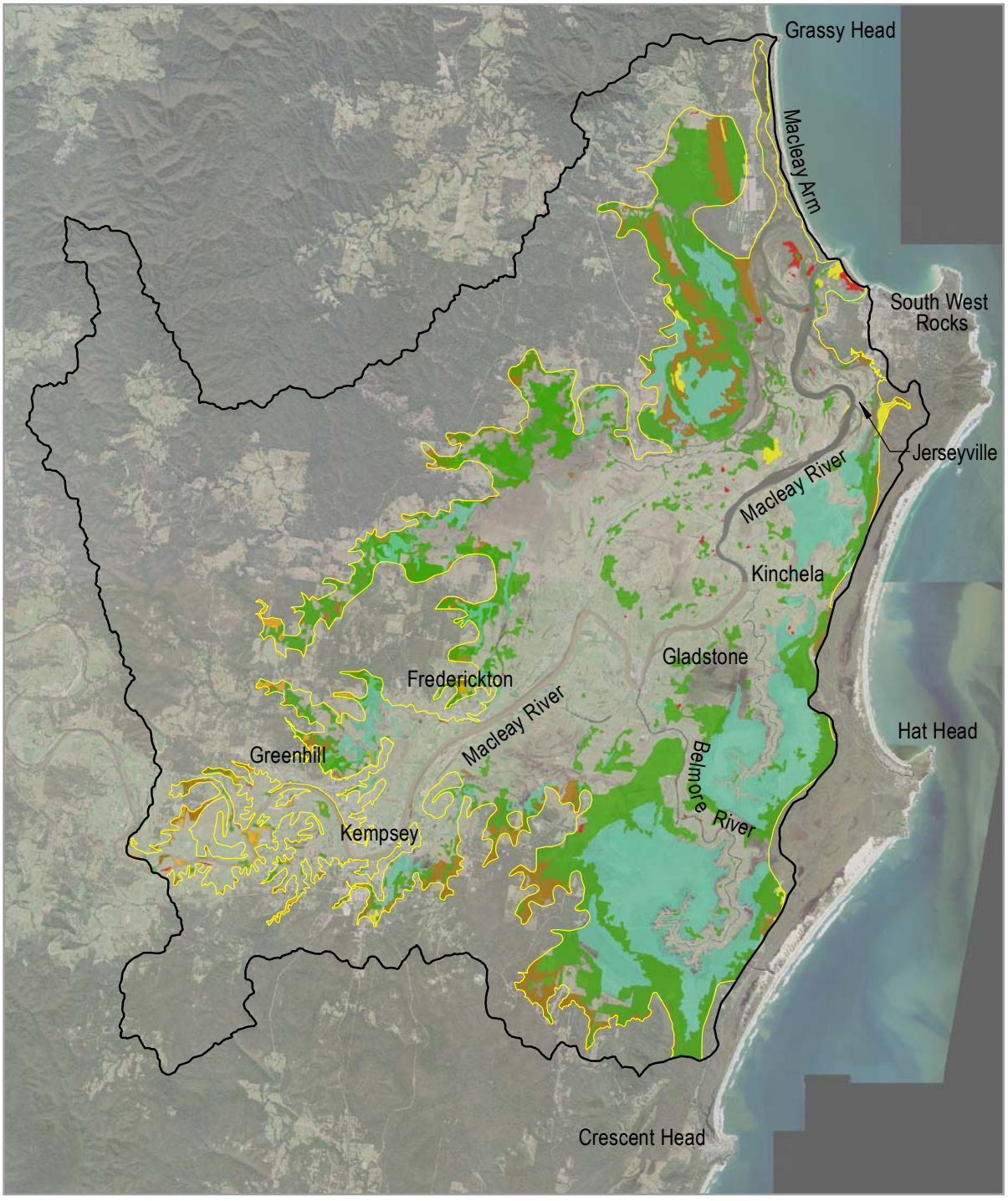


LEGEND

- Study area
- MREMP Floodplain study area
- Coastal Scrub/Heath
- Dry Sclerophyll Forest
- Rainforest
- Swamp Sclerophyll Forest
- Wet Sclerophyll Forest
- Wetland (Freshwater)

0 5 km

North

**Key Threatened Flora Habitat Types within the MREMP Study Area Floodplain**

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1352728

Illustration 10.3

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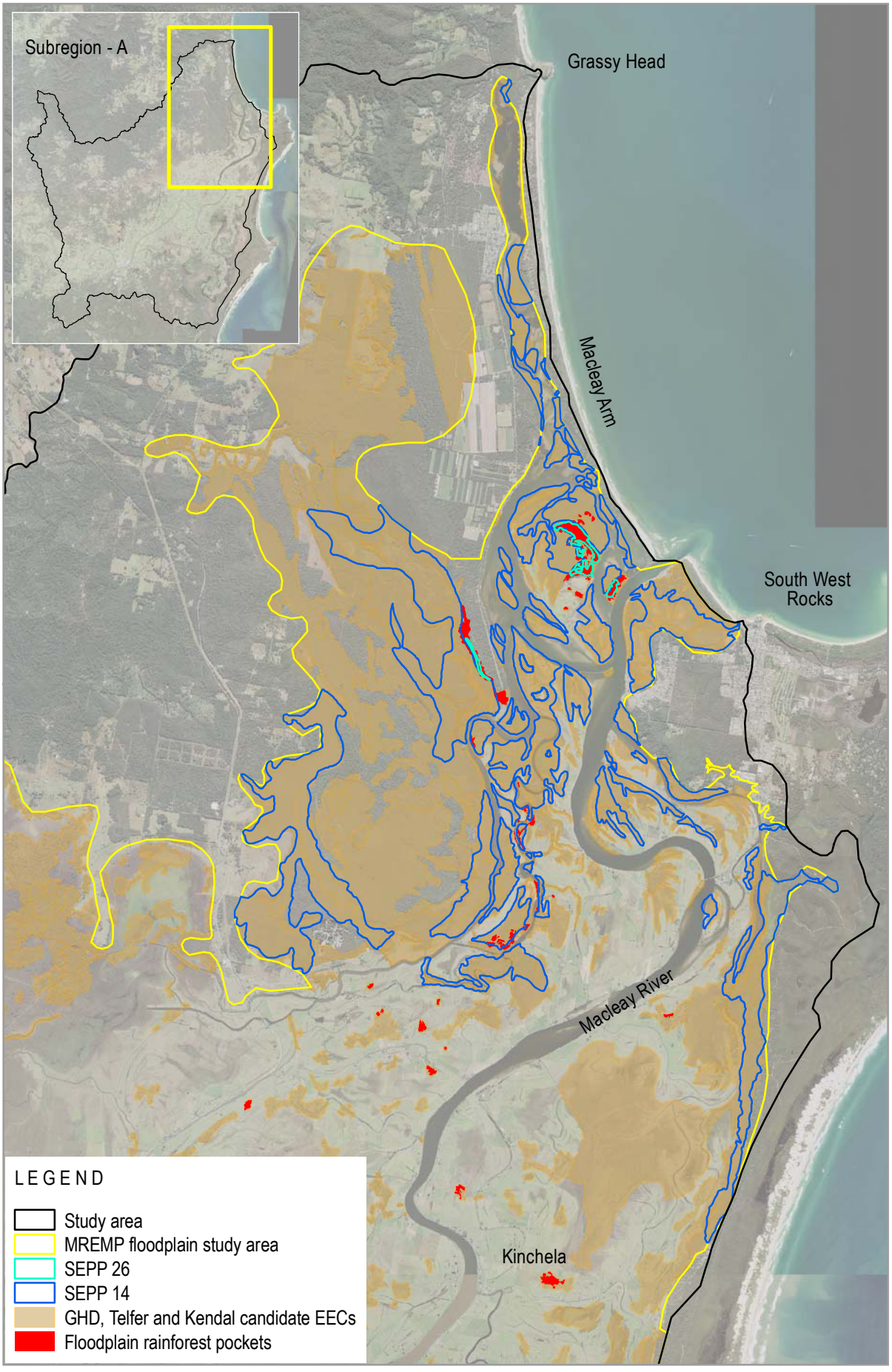


0 2 km

North

**Known and High Probability EECs within the MREMP Study Area Floodplain - Subregion A**

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352729

Illustration 10.4

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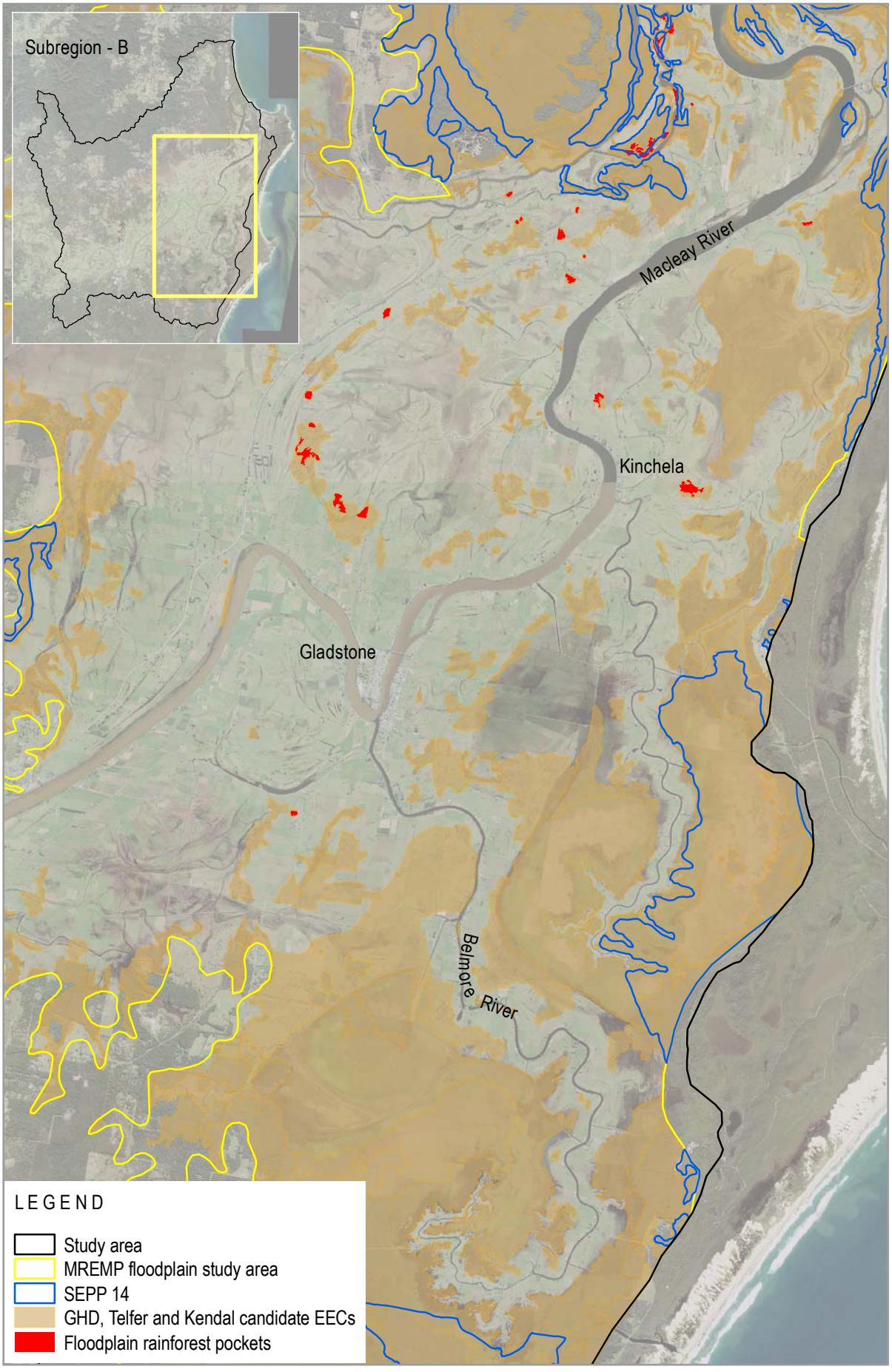


0 2 km

North

**Known and High Probability EECs within the MREMP Study Area Floodplain - Subregion B**

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352730

Illustration 10.5

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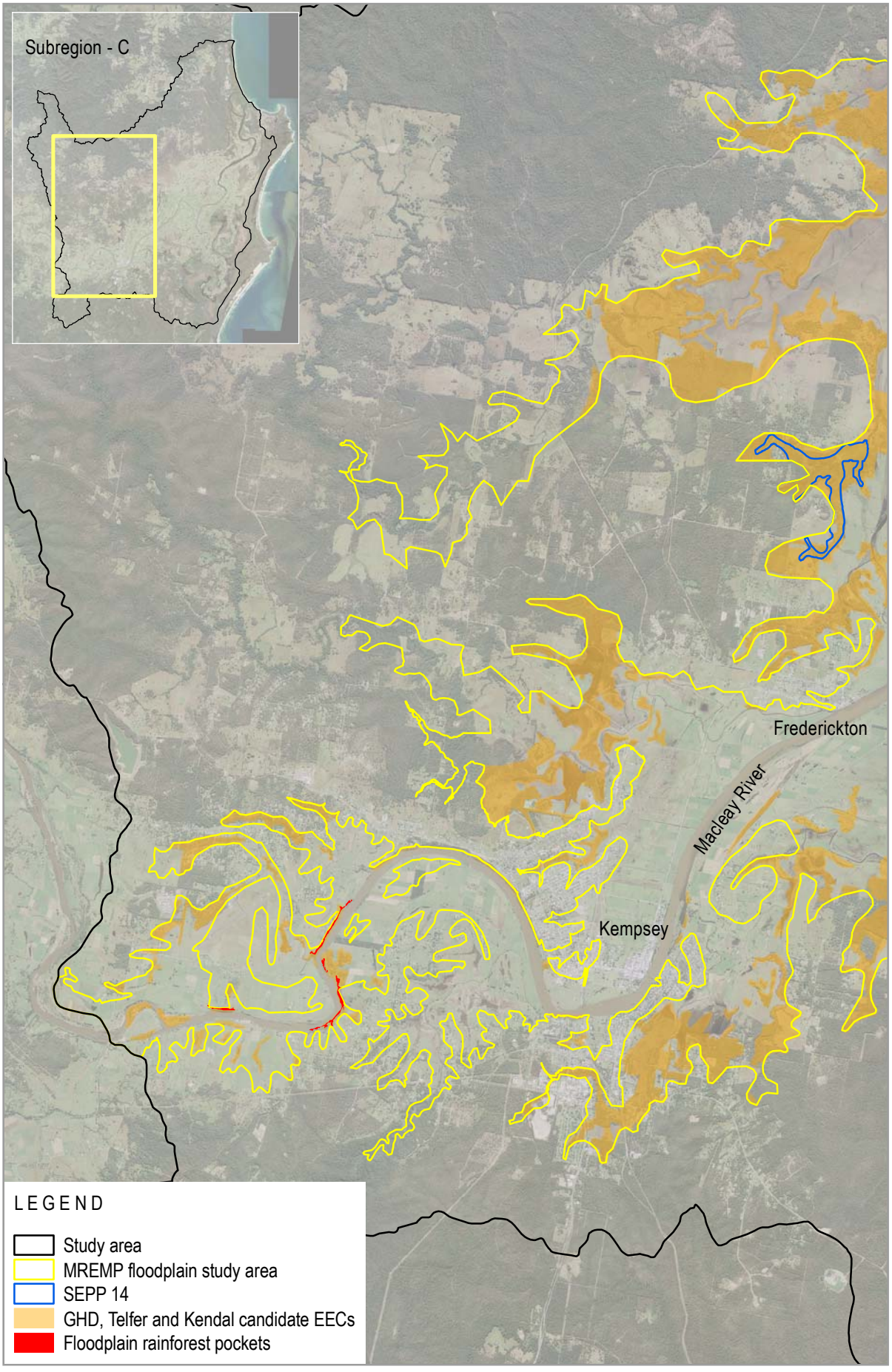
*Source of base data: Kempsey Shire Council and Planning NSW*



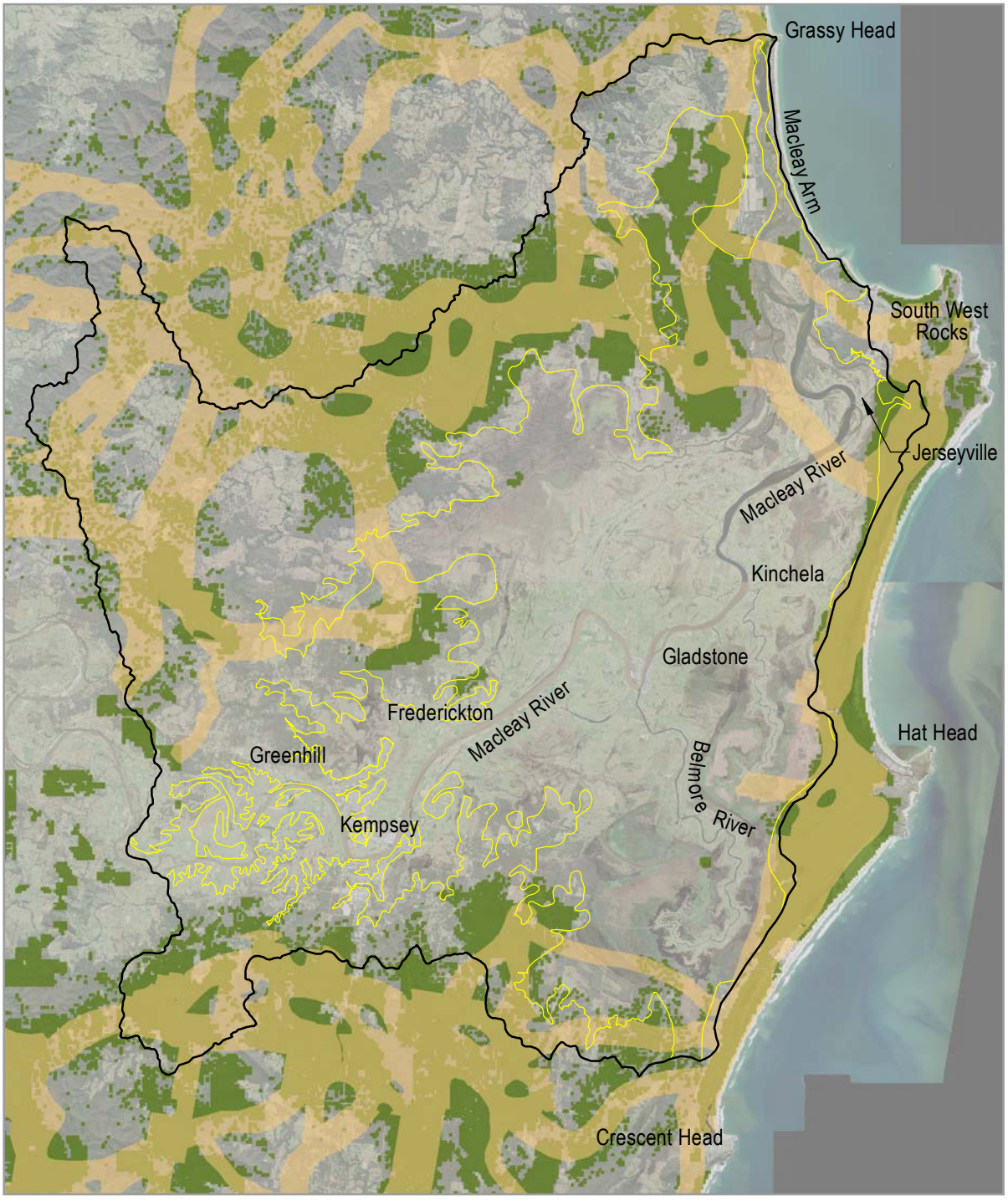

0 2 km

North

**Known and High Probability EECs within the MREMP Study Area Floodplain - Subregion C**

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council and DECCW*




LEGEND

- Study area
- MREMP floodplain study area
- Corridors
- Key habitats

0 5 km

North

# DECCW Mapped Regional Corridors

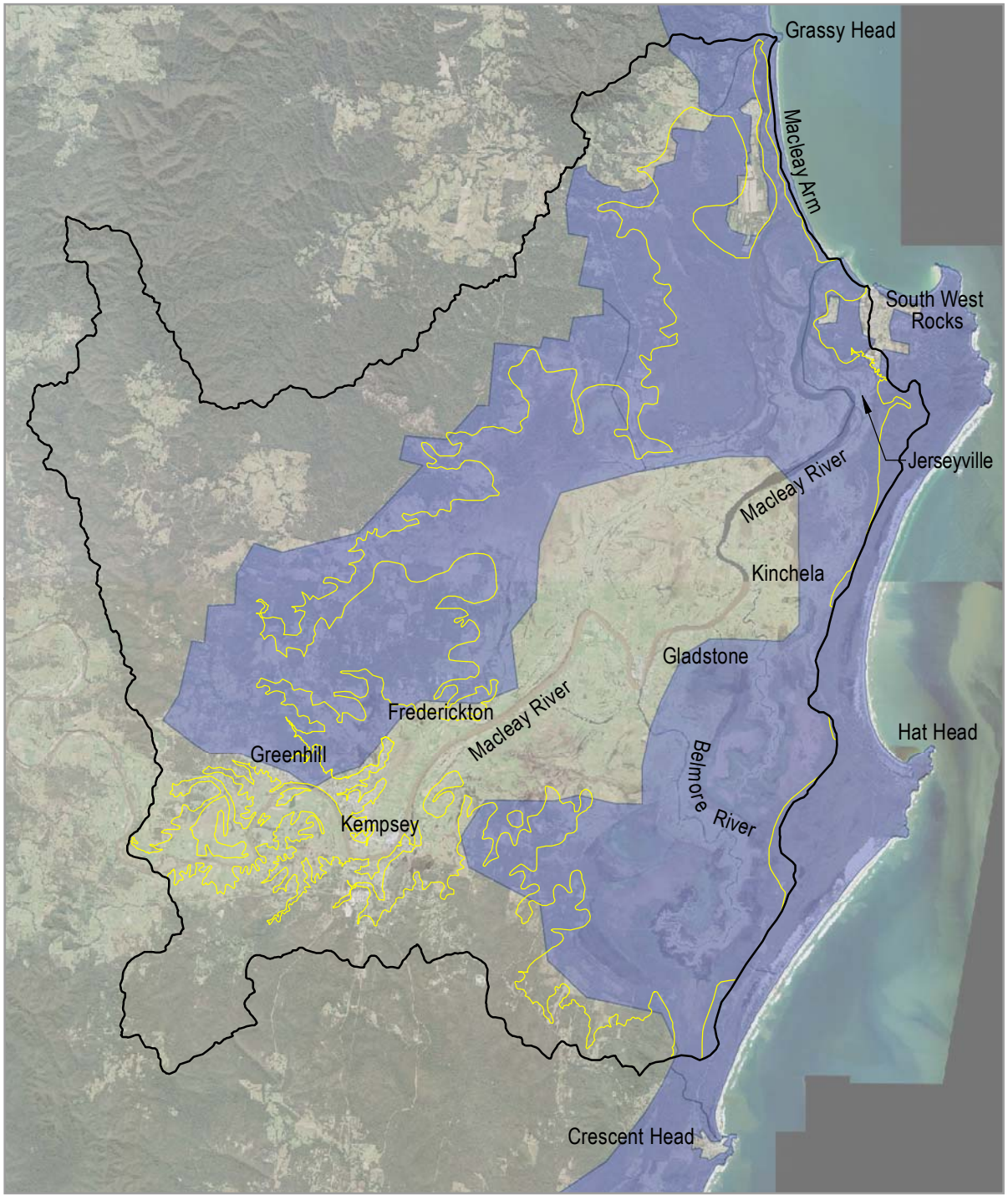
GeoLINK environmental management and design

Macleay River Estuary Management Study
1352732

Illustration 10.7

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council and DECCW*




LEGEND

- Study area
- MREMP floodplain study area
- Coastal corridor

North

0 5 km

# DECCW Mapped Coastal Complex Climate Change Corridors

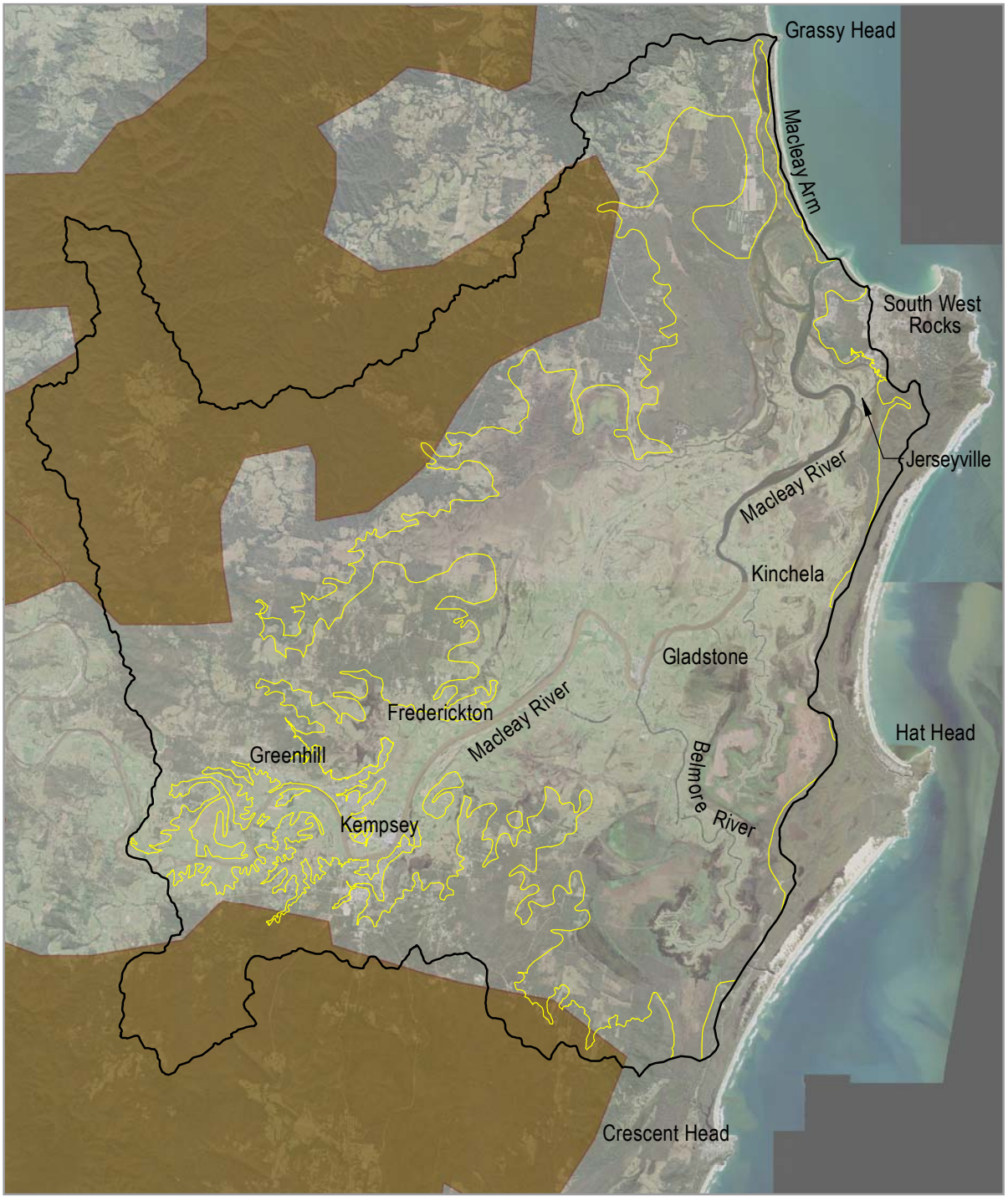
GeoLINK environmental management and design

Macleay River Estuary Management Study
1352733

Illustration 10.8

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council and DECCW*




LEGEND

- Study area
- MREMP floodplain study area
- Dry corridors

0 5 km

North

# DECCW Mapped Dry Forest Climate Change Corridors

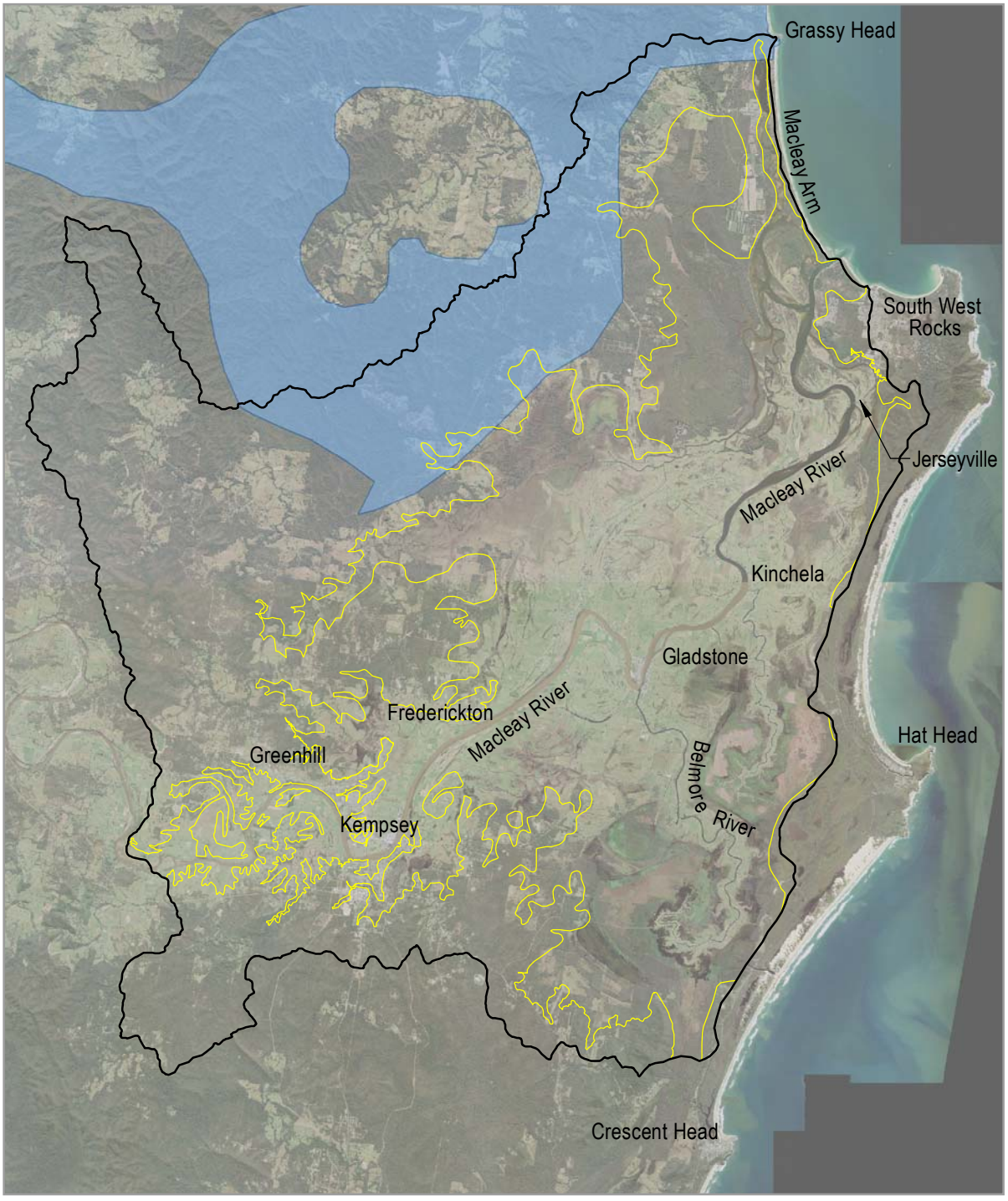
GeoLINK environmental management and design

Macleay River Estuary Management Study
1352734

Illustration 10.9

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council and DECCW*




LEGEND

- Study area
- MREMP floodplain study area
- Moist corridors

0 5 km

North

# DECCW Mapped Moist Forest Climate Change Corridors

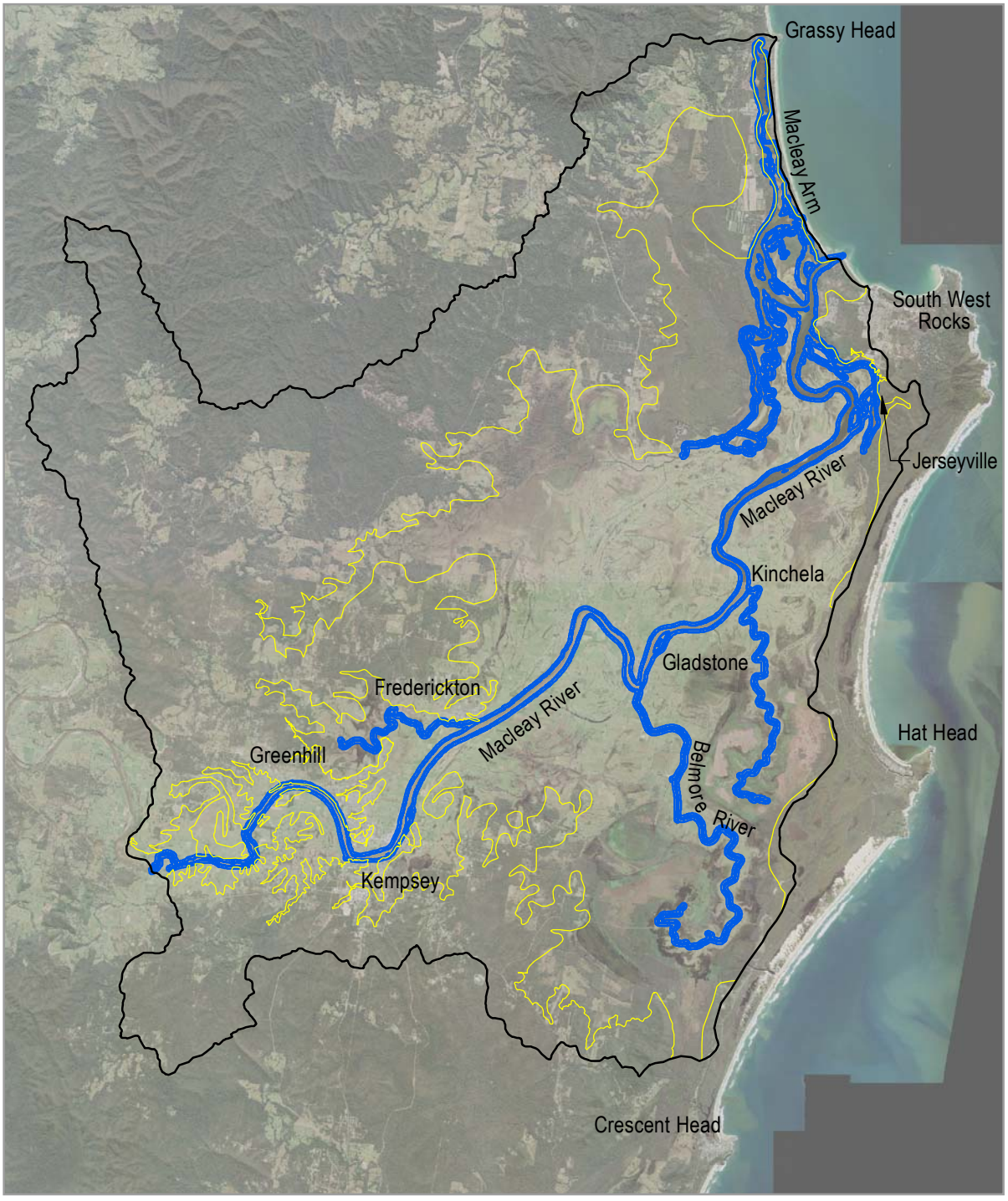
GeoLINK environmental management and design

Macleay River Estuary Management Study
1352735

Illustration 10.10

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*




LEGEND

- Study area
- MREMP floodplain study area
- Macleay estuary riparian corridor

0 5 km

North

# Macleay Estuary Riparian Corridor

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352736

Illustration 10.11

## 10.2 Issues

Based on the information above, two main issues have been identified in relation to habitat protection:

- the above identified high conservation value habitats types and corridors collectively cover a significant portion of the MREMP study area floodplain. Many of the mapped habitat units are however highly fragmented and disturbed, thus further investigations are required to prioritise areas for conservation management purposes; and
- review of the KSC LEP 1987 found that only 4.7% (2069.35 ha) of the MREMP study area floodplain is under environmental protection or existing/proposed national parks estate zonings (Birch and GeoLINK 2010). The majority of land is under rural zonings, despite some of these areas supporting national parks estate (only 524.78 ha or 1.19% of which is zoned 8(a) (Existing National Parks, Nature Reserves), Birch and GeoLINK 2010); SEPP 14 – Coastal Wetlands; SEPP 26 - Littoral Rainforest; and habitats for threatened species and EECs. Subsequently there are some obvious inconsistencies between land uses, environmental values and the existing KSC LEP mapping. Land use planning changes are considered necessary to ensure consistency between legislative habitat protection measures and to help protect, maintain or enhance the biodiversity values of the MREMP estuary and floodplain.

## 10.3 Management Objectives

The objectives of this part of the EMS are to:

1. Prioritise threatened species habitats and EECs on the MREMP study area floodplain for conservation management purposes, using currently available information; and
2. Develop a prioritised list of land use planning changes to adequately protect important habitats.

It should be noted that there is insufficient data currently available to identify priority habitat areas for threatened and migratory shorebirds, and associated conservation management actions along the Macleay Estuary (Sandpiper Ecological Surveys 2009).

### 10.3.1 Setting Priorities for Habitat Protection

The previously discussed floodplain habitat areas for threatened species and EECs (**Section 10.1**) were used as the first step for prioritising high conservation value floodplain habitats. To further identify high conservation sites, the following factors are considered important:

- habitat condition, prioritising less disturbed sites;
- size of habitat area, prioritising larger sites;
- proximity and connectivity, prioritising sites that are interconnected or in close proximate in favour of isolated sites;
- prioritising areas of dual legislative significance (e.g. SEPP 14 – Coastal Wetlands, SEPP 26 – Littoral Rainforest, SEPP 44 Koala Habitat Protection, TSC Act, EPBC Act EECs, etc;
- existing landuse regime, for example, prioritising sites currently subject to grazing but providing low quality/carrying capacity grazing land;
- site vulnerability; and
- representativeness.

Due to information gaps, not all of the above considerations were able to be considered when identifying priority areas (e.g. existing landuse regime), though other factors may provide an indication of such factors (e.g. habitat conditions). As Phillips and Hopkins (2009a, 2009b) have also previously undertaken Koala habitat mapping and identified Koala management areas as a priority areas for the management of Koalas

(refer to **Section 10.1**), this is not replicated as part of this investigation. Collectively, the factors below were used to identify priority habitat areas.

***Habitat Condition***: Telfer and Kendall (2006) vegetation mapping included nominating a disturbance intensity class attribute to most mapped polygons. These classes are illustrated in **Table 10.4** below.

**Table 10.4 Disturbance intensity classes**

| *Class* | *Disturbance Intensity* | *Description* |
|---|---|---|
| 0 | Negligible | Disturbance not visible or confined to very small isolated points |
| 1 | Low | Some disturbance is visible but covers only small portion |
| 2 | Moderate | Disturbance is widespread but natural vegetation retains some structural and floristic integrity |
| 3 | High | Disturbance is severe and natural vegetation is significantly denuded both structurally and floristically |
| 4 | Very high | Disturbance is severe natural vegetation is absent |

Areas nominated as having negligible and low disturbance intensity were favourably considered as high priority habitat areas.

Only parts of the study area mapped by Telfer and Kendall (2006) were able to be considered by this attribute. Review of the GHD (2007) vegetation mapping GIS layer over the western part of the study area does not include any habitat condition parameters.

***Proximity and Connectivity***: Habitat proximity and connectivity was identified through assessing available vegetation/habitat mapping in associated with SEPP 14 – Coastal Wetlands mapping, SEPP 26 – Littoral Rainforest mapping, national parks estate mapping and relevant corridor mapping. Habitat areas within relevant mapped corridors, 100 m of SEPP 14 – Coastal Wetlands, 100 m of SEPP 26 – Littoral Rainforest or 100 m of national parks estate mapped areas were favoured as priority habitat areas.

***SEPP 14 and SEPP 26***: These areas were identified through reviewing of SEPP 14 – Coastal Wetlands and SEPP 26 – Littoral Rainforest mapping. Areas mapped in these areas were considered to be high priority conservation areas.

**Table 10.5** below shows the classes and criteria used to identify priority high conservation value areas within the MREMP study area floodplain. In total, 18440 ha (43.7%) of the MREMP study area floodplain was identified as high priority habitat areas for conservation management purposes. These areas are show in **Illustration 10.12**. The area encompassed by each priority class is shown below in **Table 10.6**. It should be noted that some of the high priority areas overlap existing national parks estate, hence are already managed for conservation purposes.

**Table 10.5 Priority Classes for Threatened Species Habitats and EEC**

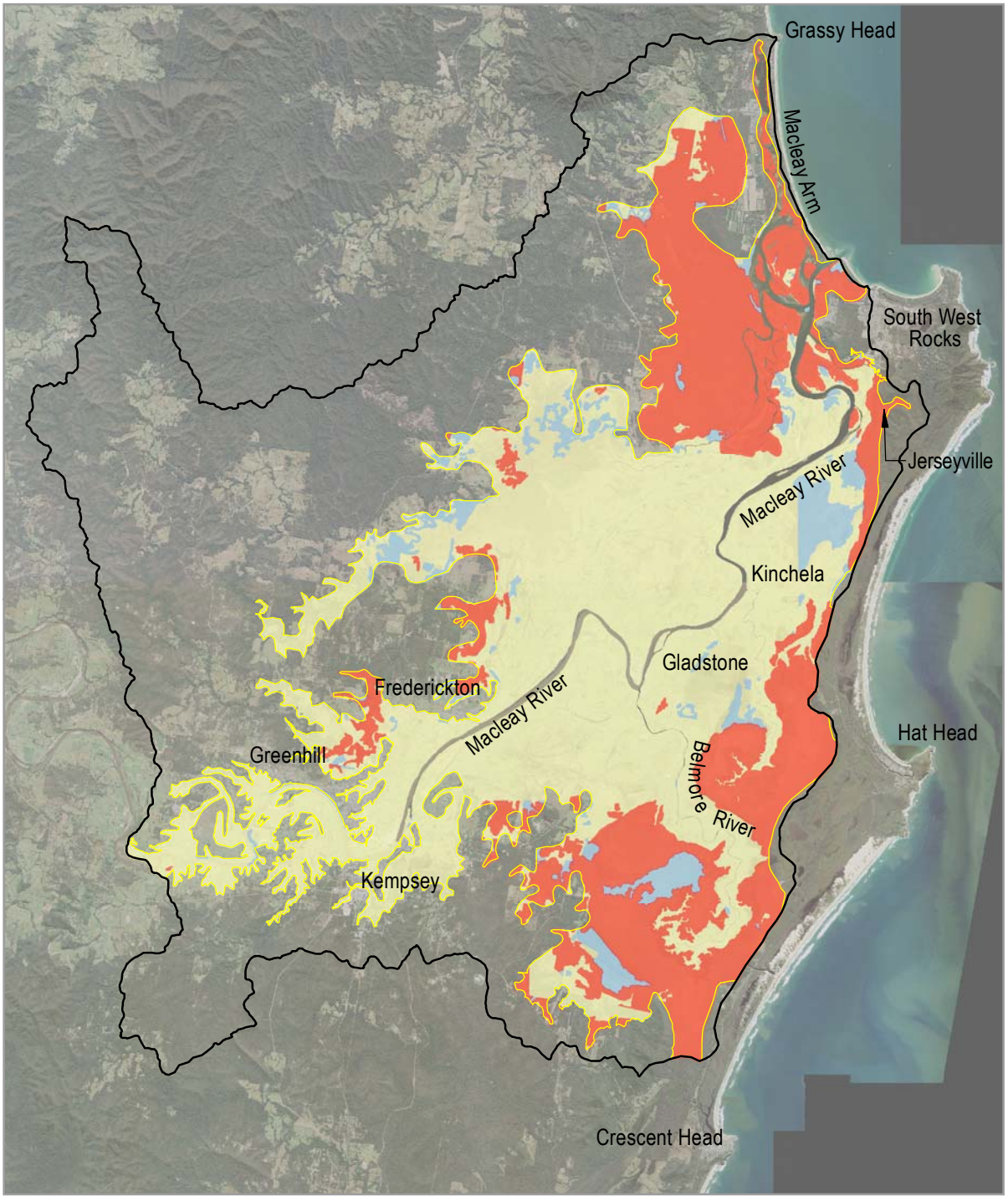
| *Priority Class* | *Description* |
|---|---|
| High | **1)** SEPP 14 – Coastal Wetlands.<br>**AND / OR**<br>**2)** SEPP 26 – Littoral Rainforest.<br>**AND / OR**<br>**3) Key threatened species habitat types** (Dry Sclerophyll Forest, Wet Sclerophyll Forest, Swamp Sclerophyll Forest, Coastal Scrub/Heath, Rainforest, Estuarine, Wetland (Freshwater); and Water surfaces) **OR known/likely EECs habitats** (including Telfer and Kendall (2006) mapped Candidate EECs, "Potential EEC B Region" GIS layer provided by KSC, and ID Landscape Management (2005) as "floodplain rainforest pockets"):<br>▪ within 100m of a national parks estate, SEPP 14 – Coastal Wetlands or SEPP 26 – Littoral Rainforest;<br>**and/or**<br>▪ with Disturbance Intensity Class: Low (1) or Negligible (0) and within the Riparian Corridor or DECCW mapped regional, subregional or climate change corridor. |
| Medium | **1) Key threatened species habitat types** (Dry Sclerophyll Forest, Wet Sclerophyll Forest, Swamp Sclerophyll Forest, Coastal Scrub/Heath, Rainforest, Estuarine, Wetland (Freshwater); and Water surfaces) **OR known/likely EECs habitat** (including Telfer and Kendall (2006) mapped Candidate EECs, "Potential EEC B Region" GIS layer provided by KSC, and ID Landscape Management (2005) as "floodplain rainforest pockets):<br>▪ within the Riparian Corridor or DECCW mapped regional, subregional or climate change corridor; **and**<br>▪ with Disturbance Intensity Class: moderate (2). |
| Low | Other areas of the MREMP floodplain study area. |

**Table 10.6 Areas of High Conservation Value Habitat Prioritisation Classes**

| *Priority Class* | *Approximate Area (ha)* | *Approximate Percentage of MREMP Study Area Floodplain* |
|---|---|---|
| High | 18440 | 43.7 |
| Medium | 2389 | 5.7 |
| Low | 21326 | 50.6 |

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: August 2010*
*Source of base data: Kempsey Shire Council*




LEGEND

- Study area
- MREMP floodplain study area
- High priority
- Medium priority
- Low priority

0 5 km

North

# Priority Habitats for Conservation Management Purposes

GeoLINK environmental management and design

Macleay River Estuary Management Study
1352737

Illustration 10.12

### 10.3.2 Habitat Protection Objectives

Based on the principles and priorities discussed above, the following objectives for habitat protection in the Macleay estuary have been developed:

***Management Objective 10/1*** Identify high priority conservation value habitats; and

***Management Objective 10/2*** Protect and manage important habitat areas.

## 10.4 Management Strategies

### 10.4.1 Amend Council LEP Land Zoning to Protect Important Habitat

***Summary:*** The identified high priority conservation value habitats shown in **Illustration 10.12** are predominantly located**: in** the Yarrahapinni Wetland area; adjoining Hat Head National Park; and in the Belmore and Kinchela wetland areas. A significant portion of this high priority area is located in National Park estate or areas zoned Coastal Land Protection under the KSC LEP mapping. Protection zoning should be pursued for appropriate high priority areas not currently located in National Park estate or under a protection zoning.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Identify sites with high priority conservation value habitats | 10/1 | Identified in this EMS (see **Illustration 10.12**) |
| Identify strategic high priority areas (that are not located in National Park estate or under a protection zoning) to enhance connectivity and provide other benefits such as improved representativeness | 10/1 | KSC, DECCW, DPI Fisheries (saltmarsh), NRCMA |
| Provide further assessment of strategic high priority areas identified in previous step to confirm habitat value (to confirm findings in this EMS which has been based on amalgamation of information from aerial photograph and desktop assessment) | 10/1 | KSC, DECCW, DPI Fisheries (saltmarsh), NRCMA |
| Undertake further necessary investigations (including ground-based surveying and community consultation) to assist in the rezoning of identified strategic high priority areas | 4/3<br>10/2 | KSC, DECCW, DPI Fisheries (saltmarsh), NRCMA |
| Amend the KSC LEP mapping to ensure strategic high priority habitat areas are appropriately zoned for habitat protection (e.g. Environmental Protection) | 4/3<br>10/2 | KSC |

### 10.4.2 Encourage BioBanking of Important Habitat Areas

***Summary:*** BioBanking provides an opportunity for rural landowners biodiversity values on their land to generate income by managing the land for conservation. 'Biodiversity credits' can be generated by landowners who commit to enhance and protect biodiversity values on their land through a biobanking agreement, and these credits can then be sold, generating funds for the management of the site. The credits can be sold to those seeking to invest in conservation outcomes or counterbalance (offset) the impacts on biodiversity values that are likely to occur as a result of a development. This strategy aims to inform, encourage and provide assistance to landholders with high priority habitats for conservation management, to develop BioBanking agreements and gain credits to help protect and manage these areas.

| Steps Required | Objectives Addressed | Key Responsibilities |
|---|---|---|
| Identify sites with high priority conservation value habitats | 10/1 | Identified in this EMS (see **Illustration 10.12**) |
| Liaise with landholders of areas identified above to inform and encourage to develop BioBanking agreements | 4/3<br>10/2 | KSC, DECCW |
| For landholders interested in pursuing BioBanking agreements, provide further assessment of high priority areas on their properties of interested to confirm habitat value (to confirm findings in this EMS which has been based on amalgamation of information from aerial photograph and desktop assessment) | 4/3<br>10/1<br>10/2 | KSC, DECCW, DPI Fisheries (saltmarsh), NRCMA |
| Assist interested landholders to develop BioBanking agreements and gain credits to help protect and manage these areas | 4/3<br>10/1<br>10/2 | KSC, DECCW |

### 10.4.3 Encourage Landholder Management of Important Habitat Areas

***Summary:*** A range of non-legislative incentives and grants are available to help land holders protect and manage significant habitats on private land for conservation purposes. These programs are available through a number of funding sources. This strategy aims to inform, encourage and provide assistance to landholders with identified high value habitats to gain funding and implement conservation management activities.

| Steps Required | Objectives Addressed | Key Responsibilities |
|---|---|---|
| Identify sites with high priority conservation value habitats | 10/1 | Identified in this EMS (see **Illustration 10.12**) |
| Liaise with landholders of areas identified above to inform and encourage seeking funding and implement conservation management activities | 4/3<br>10/2 | KSC, DECCW, DPI Fisheries (saltmarsh), NRCMA, Landcare |
| For landholders interested in implementing conservation management activities, provide further assessment of high priority areas on their properties of interested to confirm habitat value (to confirm findings in this EMS which has been based on amalgamation of information from aerial photograph and desktop assessment) | 4/3<br>10/1<br>10/2 | KSC, DECCW, DPI Fisheries (saltmarsh), NRCMA |
| Assist interested landholders to gain funding, develop conservation management plan and implement conservation management activities to help protect and manage these areas | 4/3<br>10/1<br>10/2 | KSC, DECCW, DPI Fisheries (saltmarsh), NRCMA, Landcare |

### 10.4.4 Further Investigate the Possibility of Establishing a Sanctuary Zone in Yarrahappinni Wetlands National Park

***Summary:*** The combination of a fishing closure in the waters upstream of the floodgates and the bund wall levee and access restrictions due to the floodgates and levee mean that the Yarrahapinni Wetlands National Park acts as a *de facto* MPA, most similar to an aquatic reserve in nature. The high ranking of the Yarrahapinni area as a suitable location for a candidate MPA (Birch and GeoLINK, 2010), the potential acceptance of it as an Aquatic Reserve to the general public and stakeholders and the existing barriers to access may make it ideal as a formalised Aquatic Reserve for the Macleay River estuary system.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Liaison between authorities in respect to investigate the feasibility and need of establishing an Aquatic Reserve in Yarrahapinni Wetlands National Park | 10/2 | KSC, DECCW, PWG, DPI Fisheries NRCMA |
| Conduct a community consultation process in respect to establishing an Aquatic Reserve in Yarrahapinni Wetlands National Park | 10/2 | KSC, DECCW, PWG, DPI Fisheries NRCMA |
| Abandon or proceed with establishing an Aquatic Reserve in Yarrahapinni Wetlands National Park dependant on the outcomes of the above steps | 10/2 | KSC, DECCW, PWG, DPI Fisheries NRCMA |

# 11

# Fishery Management

## 11.1 Current Status

The fisheries resources of the Macleay River support a significant estuary general fishery, significant oyster aquaculture industry and a significant recreational fishery. Estuary prawn trawling, a permitted activity on some other large NSW estuaries, is no longer permitted on the Macleay. Fisheries production, the effect of floodplain management on fisheries resources, the effects of the discharge of floodwaters upon fisheries resources and the history of fish kills on the Macleay have all been reviewed in other reports (WMA 2009, The Ecology Lab 1996).

### 11.1.1 Macleay Estuary General Fishery

The Macleay River estuary general fishery focuses mostly on finfish (including mullet, eels, luderick and whiting), crabs and prawns. The most productive employed methods on the Macleay are the mesh net, used to collect mullet, luderick, bream, flathead, mulloway and whiting, and traps for eels, other fish and crabs. Other applied methods include hauling and handlining (Birch and Andrighetto, 2010). During the initial community consultation for the current project, commercial fishing methods and perceived impacts upon fish stocks were raised as issues of concern but during the general survey only a small number of respondents noted this (7 respondents from 162).

WMA Water (2009) compiled a list of fish species known to inhabit the Macleay River estuary along with information about the lifecycle stage and habitat use. They also compiled a table of the value of targeted commercial fish species and some charts illustrating the value of commercial fishing effort in the Macleay relative to other North Coast estuaries. Their comparison of catch per estuary area across the state suggests that overfishing, one of the issues raised during community consultation, is not occurring and that commercial fish stocks and production are relatively stable. However, the data used for their analysis only cover the years 1997/98 to 2000/01, and their conclusion contradicts that of Middleton *et al*. (1985) who suggested that a reduction in productivity has been apparent over time. Middleton *et al*. (1985) presented results showing a steady decline in the production of major fin fish species (bream, luderick, sea mullet, mulloway and sand whiting) from a peak of 120,000kg in 1956 to a low of 20,000kg in 1973. He also presented data showing an overall decline in the annual production of prawns between the early 1960s and the early 1970s. An analysis of more recent data shows that total production of the estuary general industry fluctuated over the 12 years between 1997/98 and 2008/2009 (see **Illustration 11.1**). Over the same period, the average annual production of major fin fish species was approximately 55000kg with a peak of 78000 kg in 1999/2000 and a low of 33000 kg in 2000/01. From the data presented by Middleton *et al* (1985), average annual production of major fin fish species appears to have been in excess of 70,000 kg between 1956 and 1968, and below 30,000kg between 1969 and 1976. In his analysis of commercial fishing data, Middleton (1985) was not drawing attention to fishing practices but to the effects of habitat degradation on the Macleay, with particular reference to the Yarrahapinni Wetlands. In addition, it is important to note that summaries of catch in isolation to information about fishing effort and other factors can give misleading trends.

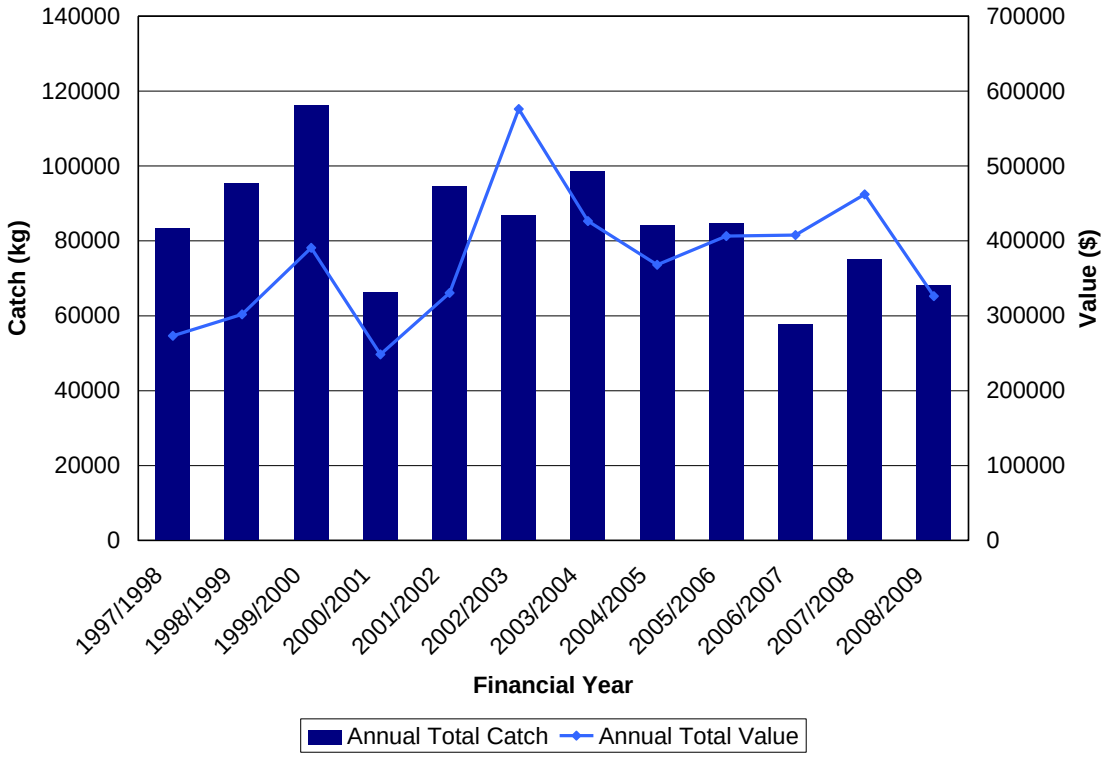
During the 12 years from 1997/98 to 2008/09 two of the three most unproductive years aligned with periods of heavy flooding on the Macleay (2000/01 and 2008/09). This is indicative of a negative impact from floodwater discharge.

The number of licensed commercial fishers working in the river was reported to be ten to eleven in 1996 (The Ecology Lab 1996). Since then the nearby Hastings and Bellinger Rivers have been declared as

recreational fishing reserves. There is some concern among the community that this has resulted in an increased number of commercial fishers operating on the Macleay River and a subsequent increase of fishing pressure.

With respect to the broader management of the Macleay River estuary, where they represent a significant industry, very little consultation with commercial fishers has occurred with the exception of The Ecology Lab (1996). Commercial fishers, as regular users of the estuary may be a source of significant knowledge that would assist with the management of the estuary. I&I NSW maintain regular consultation with the Estuary General Fishery Management Advisory Committee.

**Illustration 11.1 Annual production and value of the Macleay River estuary general fishery between 1997/98 and 2008/09**




Note: Data not adjusted for processing. Value calculated using average monthly value at Sydney Fish Markets at time of landing.

### 11.1.2 Macleay Oyster Aquaculture Industry

Oyster aquaculture is the most valuable fishery managed by NSW Industry and Investment. The Macleay contributes an annual average of approximately $500,000 worth of production. This represents approximately 124,000 dozen oysters or about 2% of the total production for NSW.

The oyster growing areas of the Macleay River are divided into three management units, or harvest areas (see **Illustration 11.3**). Of these, two are operating under conditionally restricted terms (Clybucca and Fishermans Reach harvest areas) and one (New Entrance harvest area) under conditionally approved terms (NSW Food Authority 2006a, b, c). No assessment of seasonal and long term fluctuations in the use of these areas has been undertaken as suggested by Middleton *et al*. (1985). The data to undertake such an analysis does not exist at this point in time (Phil Baker *pers comm.*). It is clear that the Clybucca harvest zone is the least widely utilised of these areas and is considered high risk in the summer months when average rainfalls are higher.

Oyster production on the Macleay has fluctuated over the past decade but without indication of a general trend. Over the long term, production has declined from a peak of almost 500000 dozen oysters in 1975 (Middleton *et al*. 1985). Whilst the decline in oyster production (and fin fish and prawn production) occurred during and shortly after the period of major flood mitigation works a direct relationship between the two factors is impossible to establish, mostly due to a lack of information.

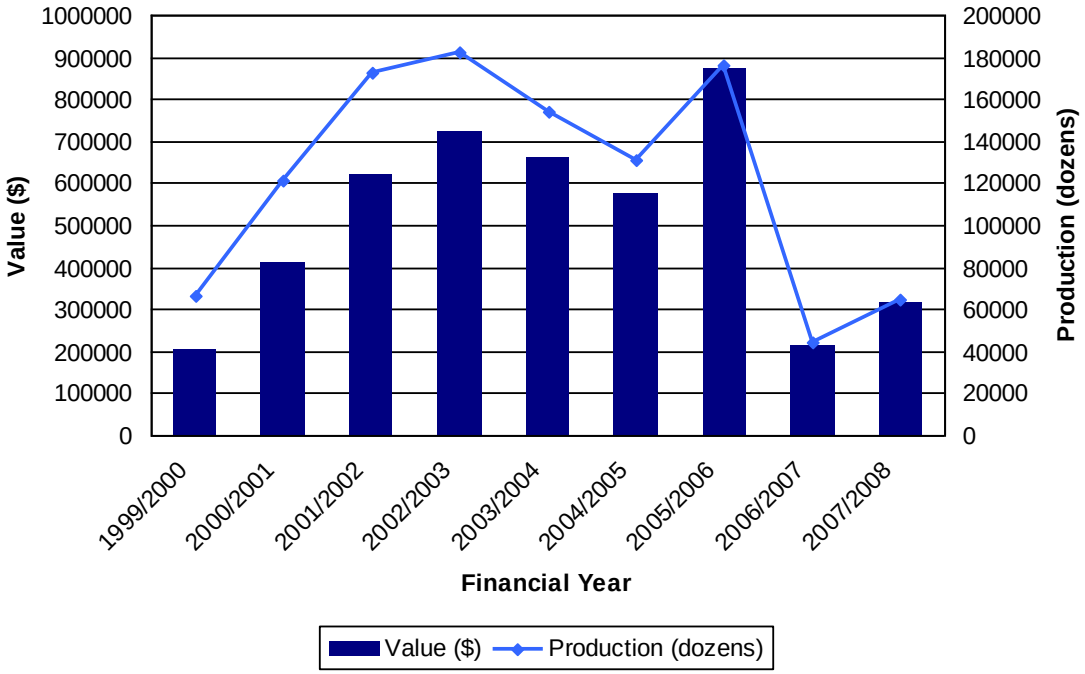
The Macleay Oyster Industry has suffered a number of setbacks in recent years. These include;

- the discovery of QX disease in August 2006 and subsequent restrictions on intersystem transport of Macleay oysters
- oyster kills in winter/spring 2008. PCR tests undertaken in the following February did not find any evidence of QX in these kills and the oyster growers did not notice the symptoms of QX in dead stock. These kills were isolated to specific leases in the New Entrance and Fishermans Reach harvest areas. No losses occurred at this time in the Clybucca harvest zone. The most likely cause of losses was considered to be a toxic agent; and
- four large consecutive freshwater events starting in February 2009 resulting in more kills and various closures. Oysters in the Clybucca area showed signs of acid caused mortality and oysters in the Fishermans Reach and New Entrance harvest areas were considered by some to die of prolonged exposure to low salinity, deoxygenated black water.

In April 2009 DECC staff undertook some testing of oysters, sediment and water to assess the possible role of agricultural pesticides in the winter/spring 2008 oyster kills. No significant pesticide residues were detected.

After an interagency meeting describing the results of the DECC pesticide investigations and a further meeting with a DECC representative and a representative from the team preparing the Macleay Estuary Management Plan in September 2009 a survey was distributed amongst Macleay oyster growers. The results of the survey, subsequent biological and chemical sediment analysis and growth mortality studies are being compiled (Birch and Andrighetto 2010).

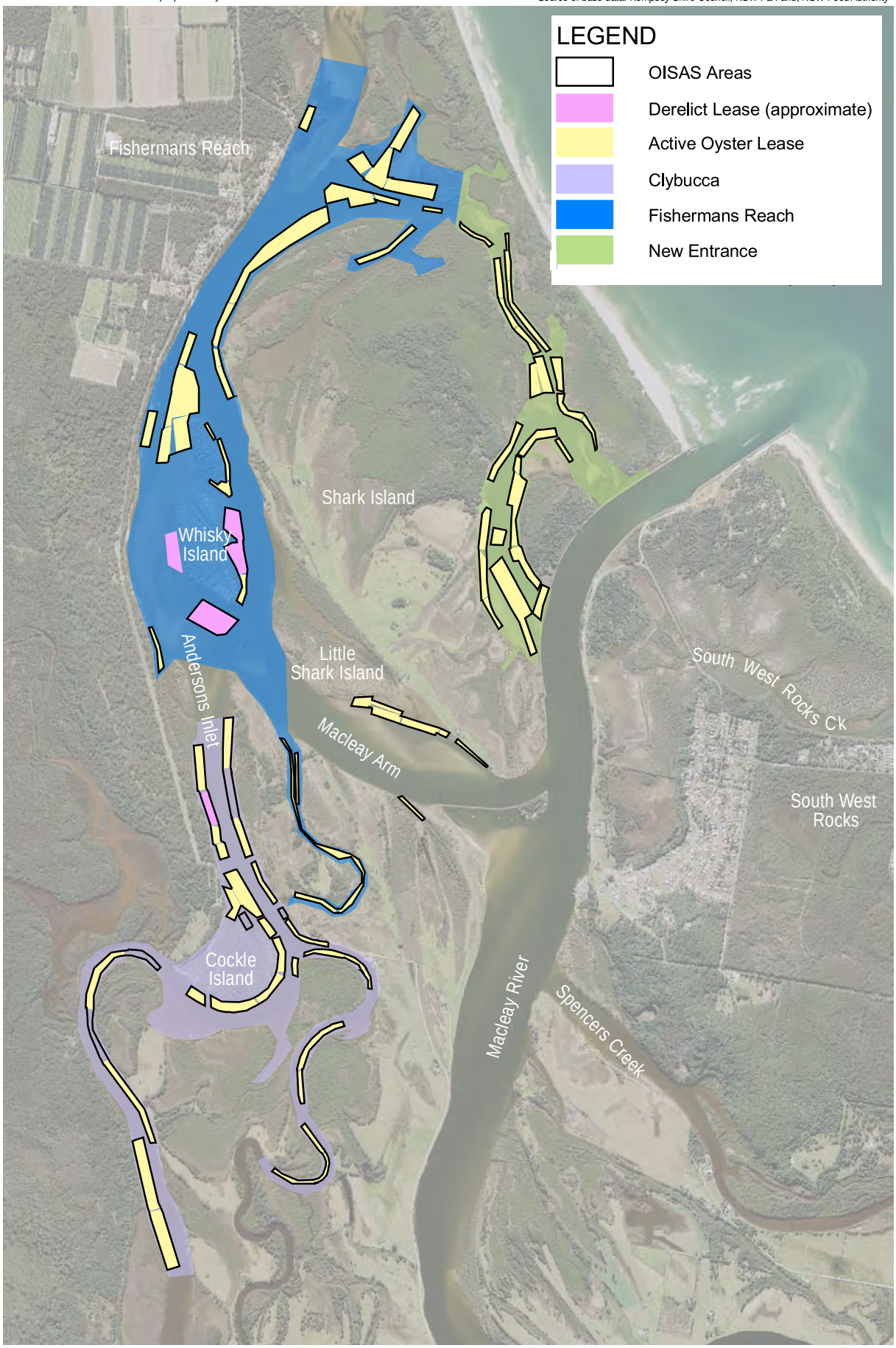
**Illustration 11.2 Production and value of the Macleay River oyster industry between 1999/2000 and 2007/08.**




Note: Data derived from annual NSW Government Aquaculture Reports.

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: July 2010*
*Source of base data: Kempsey Shire Council, NSW I & I and, NSW Food Authority*




North

0 600

## Macleay River Oyster Leases and Harvest Areas

### 11.1.3 Recreational Fishing on the Macleay

The results from a state-wide survey of recreational fishing indicate that recreational fishing could be worth in excess of $40 million to the mid north coast regional economy (Telfer 2005). This figure was calculated by multiplying the estimated number of recreational fishers in the region by the state-wide average annual expenditure per fisher and may not be accurate due to regional fluctuations in expenditure or due to the influence of visitors to the region, many of whom undoubtedly include recreational fishing as a key reason for visiting. Over 74,000 recreational fishers, representing almost 30% of the population, were estimated to have operated on the mid-north coast of NSW during the survey period (NSW Fisheries 2001). No data exists for the value of recreational fishing or the number of recreational fishers on the Macleay River estuary though it is likely to represent a significant proportion of the above numbers. The majority of the recreational catch during the survey was taken in estuarine waters and the Macleay is the second largest river system in the mid north coast region. The general survey undertaken as part of this study found that recreational fishing ranks as the second most common use of the Macleay River estuary, following boating (103 respondents from 162).

In the case of certain species, including flathead, bream, tailor and mulloway, the total state recreational catch is greater than the total state commercial catch. This information may or may not apply to the Macleay River estuary though the proportion of the total catch of these species attributable to recreational fishers is likely to be significant.

Steffe and MacBeth (2002) surveyed recreational fishing on the Macleay between July and October 2001. Their survey was timed to generate information about the recovery of the recreational fishery after catastrophic fish kills resulting from floods earlier that year. They found that over 90% of the fish caught (by weight) were luderick, yellowfin bream and dusky flathead. Limited comparisons with previously collected data indicated that the structure of fish stocks was not noticeably different after the estuary had been recovering from flood impacts for 3.5 months. Over the survey period the average monthly recreational fishing effort was approximately 20000 fisher hours. The most popular area for recreational fishers was the area around the entrance (37.5%), with the Kemps Corner/Clybucca area being the second most popular (28.4%). They found that most recreational fishing (60%) was shore based, with the other 40% undertaken from boats. During the survey period, an estimated 25 tons (45,300 individuals from 16 taxa) of fish and crustaceans were harvested from the estuary by recreational fishers.

### 11.1.4 Effects of Floodplain Management

With respect to the effects of floodplain management and flood mitigation on fisheries resources a number of documents have been compiled. These are summarized in Telfer (2005). They include reports by The Ecology Lab (1996), NSW Agriculture and Fisheries (1989), NSW Fisheries (2002) and Web McKeown and Associates (1996). NSW Agriculture and Fisheries (1989) summarises the effects of floodplain management on fisheries resources in the Macleay. That report associate the distinct downwards trend in fisheries production on the Macleay between 1955/56 and 1982/83 with the floodplain management works that occurred over the same period. They report cites the problems associated with floodplain management that have impacted on the fisheries resource as the release of deoxygenated water, the release of acid water and the loss of known nursery habitat. More information about floodplain management can be found in **Section 4** of this report.

### 11.1.5 Effects of Floodwater Discharge

With respect to the impact of floodwaters on fish stocks MacBeth *et al.* (2002) describe the recovery of fish stocks following severe flooding on the Macleay in 2001. The aims of their study were to provide information on the recovery of stocks after a major fish kill, to assist with the management decision regarding the resumption of normal fishing activity and to detect any decline in stocks associated with the resumption of normal activity. In addition, the results of their study also serve as the most comprehensive database of aquatic fauna found in the waters of the Macleay River estuary.

### 11.1.6 Fish Kills

There have been a number of significant fish kills on the Macleay River estuary system. Fish kills after flooding were rated as the issue of greatest concern in the general survey distributed as part of the present study. Whilst fish kills are a natural occurrence to a certain extent, it is widely accepted that the majority of kills are triggered by the release of oxygen poor and/or acidic water from the floodplain (eg. Richardson 1980). More details about this process are found in **Section 13**. NSW Industry and Investment maintain a database of recorded fish kills. Over the period between 1977 and 2009 42 reports of fish kills were recorded on estuarine waters of the Macleay River. The reports include kills of a few fish up to tens of thousands or tons of fish. The most commonly reported species include bream, mullet, luderick, eels, bass, estuary perch, flathead and prawns. Fish across all size categories occur within the reports. The majority of the reports include a description of the water as 'black' or 'brown' and where water quality measurements were taken they frequently describe low pH and/or low dissolved oxygen readings.

### 11.1.7 Fishing Closures

A variety of commercial and recreational fishing closures, administered by I&I NSW operate on the Macleay estuary. These are outlined in **Table 11.1** and **Table 11.2**.

**Table 11.1 Commercial Fishing Closures Operating on the Macleay River Estuary**

| *Area Affected* | *Species Affected* | *Methods Affected* | *Periods* |
|---|---|---|---|
| **Garfish Netting** | | | |
| Whole estuary | All fish species | Hauling - Use of a garfish hauling net | Midnight Friday until midnight Sunday each week and any public holiday. |
| **Prawn Count Closure** | | | |
| Whole estuary | Prawns | All methods | Any time counts are less than 125 king prawns per ½kg or 180 other prawns per ½kg. |
| **Weekend Netting** | | | |
| Whole estuary including tributaries | All fish species | Any method involving the use of a net, other than the following:<br>(a) a dip or scoop net (prawns),<br>(b) a hand-hauled prawn net,<br>(c) a hoop or lift net,<br>(d) a push or scissors net (prawns),<br>(e) a landing net. | 6pm Friday to 6pm Sunday in each week, or to 6pm Monday if Monday is a public holiday. |
| **Nets** | | | |
| All waters upstream of the Kempsey Railway Bridge | All fish species | All nets other than landing nets | All year |
| **Set Meshing Net – Lower Reaches** | | | |
| All waters lying on the northern side of a line drawn from the northern bank of Spencer's Creek to Kemp's Corner and from a line drawn east/west | All fish species | Any method involving the use of a meshing net, unless the net is used by the method of splashing. | All year |

| *Area Affected* | *Species Affected* | *Methods Affected* | *Periods* |
|---|---|---|---|
| crossing the southern end of Whiskey Island. | | | |
| **Set meshing Net – Jerseyville to Smithtown** | | | |
| Between Smithtown Bridge and the Jerseyville Bridge including tributaries | All fish species | Any method involving the use of a meshing net, other than used by the method of splashing or when set for a period of less than 2 hours. | May 1st until August 31st each year. |
| **Set meshing Net – Upper Reaches** | | | |
| Between Smithtown Bridge and the Kempsey Railroad Bridge including tributaries | All fish species | Any method involving the use of a meshing net, unless the net is used by the method of splashing. | May 1st until August 31st each year. |
| **Belmore River** | | | |
| Belmore River flood gate downstream to the road bridge at Gladstone including tributaries. | All fish species | Any netting or trapping other than an eel trap or landing net. | All year |
| **Belmore River – Upper Reaches** | | | |
| Waters of the Belmore and tributaries upstream of the flood gates. | All fish species | All nets other than landing nets | All year |
| **Yarrahapinni Wetlands National Park** | | | |
| All waters of the YWNP upstream of the confluence with Andersons Inlet. | All fish species | All methods | All year |
| **South West Rocks Creek** | | | |
| All waters of South West Rocks Creek. | All fish Species | All nets other than landing nets | All year |

**Table 11.2 Recreational Fishing Closures Operating on the Macleay River Estuary**

| *Area Affected* | *Species* | *Methods Affected* | *Time of Closure* |
|---|---|---|---|
| **South West Rocks Creek – Nets** | | | |
| Whole Creek | All fish species | All nets other than dip or scoop nets for prawns, or landing nets. | All year |
| **Macleay River – Nets** | | | |
| All waters upstream of the Kempsey Railway Bridge | All fish species | All nets other than landing nets. | All year |
| **Belmore River** | | | |
| Whole River and tributaries. | All fish species | Any method involving the use of a net or a trap, other than the following:<br>(a) a dip or scoop net (prawns),<br>(b) a landing net,<br>(c) a bait trap. | All year |
| **Yarrahapinni Wetlands National Park** | | | |

| *Area Affected* | *Species* | *Methods Affected* | *Time of Closure* |
|---|---|---|---|
| All waters of the YWNP upstream of Andersons Inlet. | All fish species | All methods | All year |
| **Spearfishing** | | | |
| All waters of South West Rocks Creek and the waters of the Macleay River downstream of a line drawn from the southernmost extremity of Shark Island to the northern edge of the public boat ramp at Mattys Flat extending out to sea 100m and 100m either side of the breakwalls. | All fish species | Spear fishing. | All year |
| **Spawning Closure** | | | |
| Whole estuary (all NSW flowing waters) | Australian bass and estuary perch | All methods | June 1st until August 31st. |

## 11.2 Issues

### 11.2.1 Threats to fishery productivity due to the drainage of floodplain wetlands.

This threat may be associated with a number of mechanisms, including the loss of upstream habitat caused by floodgates, the loss of habitat connectivity, the loss of wetland productivity to the estuary and poor water quality associated with acid water and black water runoff. The combination of all of these factors results in the reduced productivity of recreational and commercial fisheries and aquaculture.

### 11.2.2 Threats to oyster industry due to poor water quality associated with drainage and flood mitigation infrastructure.

The three shellfish harvest zones on the Macleay are all heavily dependent on the quality of water that drains from above the Clybucca floodgates. There are concerns that reduced production and heavy losses suffered by the local oyster industry have been associated with the release of acidic and deoxygenated water from this area.

### 11.2.3 Loss of key habitat.

Key fish habitat across the Macleay has been reduced via a number of mechanisms. Modification of floodplain wetlands, creeks and drains including the installation of floodgates has reduced the area of freshwater and brackish wetland available to fish. Modifications to the Yarrahapinni wetlands resulted in the loss of more than 300ha of mangroves and 80ha of saltmarsh (NPWS 2009). Anecdotal evidence and limited investigations suggest that the abundance of seagrass habitat has reduced in the main channel of the Macleay River and Spencers Creek, most likely as a result of heavy sediment loads from soil and bank erosion exacerbated by floods in recent years.

### 11.2.4 Loss of productive fishing grounds to jetty, wharf and pontoon development.

Poorly planned development of jetties, wharves and pontoons can result in the loss of previously productive fishing grounds. Methods that can be affected include hauling and meshing.

### 11.2.5 Derelict oyster leases

Derelict oyster leases were raised as an issue during community consultation. A derelict oyster lease is defined as a lease that contains any amount of derelict cultivation material and which is no longer held under a current lease agreement. At any time a number of oyster leases in the three harvest zones on the Macleay River will be uncultivated. However, there are also a number of derelict leases on the Macleay which, under the NSW Oyster Industry Sustainable Aquaculture Strategy, require cleaning up. The material left on these leased areas includes posts, racks and a conveyor belt. The condition of the

signage and posts is poor and some of the material is considered to be a navigation hazard. I&I NSW records indicate that there are four derelict oyster leases in the Macleay River (see **Illustration 11.3**). Two of these have recently been taken up in the 2010 "Derelict Lease Offer" and will be cleaned up in accordance with a workplan agreed between the District Fisheries Officer and the lessee. One lease is the subject of current legal action against the lessee by I&I NSW. The final lease is targeted for rehabilitation.

In general derelict oyster leases are the result of natural disasters including disease and pest outbreaks, and walk-off by farmers. The primary responsibility for derelict oyster leases lies with the former lessee and/or aquaculture permit holder, however, the State assumes this responsibility if those responsible can no longer be pursued. I&I NSW has in place a range of programs designed to reduce the incidence of derelict lease area and improve the viability and environmental performance of the oyster industry. These include:

- Oyster Lease Bond System. The bonds apply to all oyster farmers in NSW. The system was introduced to ensure that the industry shares the responsibility in the future for problems arising from lease management and maintenance issues;
- NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS). This sets out a blueprint for a sustainable and viable industry;
- Compliance program. I&I NSW Fisheries Officers undertake regular inspections of oyster leases. A variety of action is taken in relation to leases that do not comply with neat and tidy provisions and other requirements of the Fisheries Management Act 1994;
- Clean up action and debt recovery. Commencing 1 July 2009, I&I NSW commenced a specific clean up and debt recovery program against individual lease holders who have failed to fulfill their responsibilities in relation to the cleanup of terminated oyster leases;
- Tarred timber replacement. The majority of the NSW oyster industry is rapidly replacing tar treated timber with more environmentally sustainable infrastructure and farming methods;
- Funding for clean up. The removal of abandoned derelict oyster lease material is very expensive. I&I NSW will continue to apply for funding to continue the work.

Threats to navigation should be reported to NSW Maritime and reports about specific oyster leases can be made to the local NSW I&I (Fisheries) and Compliance office.

### 11.2.6 Inadequate response of State government agencies to oyster mortality events

During the course of consultation, Macleay River oyster growers have indicated that they are not aware of a clear chain of command for the reporting of and response to oyster mortality and other issues. In addition, they have felt that the protocol for the response of the relevant agencies to oyster mortality events is not clearly defined. A potential result of this is that the response to oyster mortality events may be too slow to adequately study the causes.

## 11.3 Management Objectives

The estuary management study objectives for fishery management are:

| | |
|---|---|
| ***Management Objective 11/1*** | Improve the fishery productivity of the Macleay River estuary system; |
| ***Management Objective 11/2*** | Minimise fine sediment loads that impact upon estuarine habitat, infill productive fishing holes and reduces water quality. The management strategies that relate to this objective are found in **Section 13**; |
| ***Management Objective 11/3*** | Reduce the incidence of fish kills and oyster mortality related to poor export water quality from floodplain wetland areas. The management strategies that relate to this objective are found in **Section 4**; |

| | |
|---|---|
| ***Management Objective 11/4*** | Consider the needs of commercial fishers in the planning approval process for wharves, jetties and pontoons; |
| ***Management Objective 11/5*** | Reduce the risk and eyesore associated with derelict oyster leases; |
| ***Management Objective 11/6*** | Clarify the protocol for the reporting of and response to oyster mortality events on the Macleay River. |

## 11.4 Management Strategies

### 11.4.1 Incorporate commercial fishing requirements into the planning approvals process for wharves, jetties and pontoons.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Define areas within the Macleay River estuary that are regarded as high value fishing grounds for methods that could be impacted by pontoon, jetty and wharf development. This may be difficult as commercial fishers consider such information to be intellectual property. | 11/4 | I&I NSW in consultation with local fishers. |
| Develop a system of screening proposed developments on or adjacent to waterways for potential impacts on estuarine fishing grounds. | 11/4 | I&I staff are in the process of developing such a system. |
| Develop a protocol for consultation with local commercial fishers for the consideration of proposed developments where potential impacts on fishing grounds exist. | 11/4 | I&I, LPMA and KSC. |
| Incorporate the above systems into the local and state planning approvals process | 11/4 | LPMA, KSC, Department of Planning. |

### 11.4.2 Define clear protocols for the reporting on and responding to oyster mortality events.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Draft and send a mortality reporting package to all Macleay River oyster growers that include existing standard documentation outlining their responsibilities when significant oyster mortality is noted. | 11/6 | I&I |
| In consultation with the relevant state agencies, develop and report a clear protocol for the response to oyster mortality events. The protocol should address the specific role of each department and their individual units, acceptable timeframes for a response, public notification requirements and funding avenues for any research related to an oyster mortality event. | 11/6 | NSW Oyster Industry, I&I, DECCW, NSW Food Authority |

### 11.4.3 Clean up derelict oyster leases

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Where derelict leases are located in desirable areas identified as priority oyster aquaculture areas encourage uptake of leases by offering incentives for cleanup. This has already been undertaken on the Macleay, with two oyster leases identified as derelict recently leased. | 11/5 | I&I |
| Clear all cultivation materials, wave barrier fences, equipment, stock and marker posts from leases identified as derelict. | 11/5 | I&I, preferably with input from local oyster growers and funding from DECCW or CMA. |
| Enforce the standards for decommissioning oyster aquaculture leases described in the NSW Oyster Industry Sustainable Aquaculture Strategy (DPI 2006). | 11/5 | I&I |

# Threatened Species

## 12.1 Current Status

### 12.1.1 Aquatic Threatened Species

Only one listed threatened aquatic species is considered likely to occur in the waters of the Macleay River estuary with any regularity. The Black Cod, *Epinephalus daemelii*, is likely to inhabit the rocky breakwalls and protected river banks around the lower estuary (WMA Water 2009). The occurrence of black cod in the estuary has been confirmed with the sighting of a solitary individual along the northern breakwall (Birch and GeoLINK 2010).

Black cod are listed as vulnerable under the *Fisheries Management Act 1994*. The listing means that harming Black Cod or their habitat is an offence punishable by fines of up to $55,000 or one year imprisonment.

Black Cod are territorial fish, often inhabiting the same cave and small home range for years. This characteristic, their curious nature and slow movements have made them vulnerable to overfishing by line fishers and spear fishers. Estuary systems are primarily used by large juvenile fish since adults prefer near shore and off shore rocky reefs and small juveniles are most commonly found in intertidal rock pools (Fisheries Conservation and Aquaculture Branch 2009).

A draft recovery plan was published by NSW I&I in order to assist with the recovery of the species by identifying and ranking threats and prioritising recovery actions. The threats considered to carry the greatest potential risk to Black Cod include:

- hook and line fishing including setlining, trotlining and handlining (high risk);
- hook and line fishing using soft plastics (medium risk);
- hook and line fishing using droplines (medium risk); and
- spearfishing (medium risk).

Of these methods, only handlining and hook and line fishing with soft plastics are likely to occur with much frequency on the Macleay River. Spearfishing is prohibited in the areas most likely to provide habitat for black cod, including the waters around the breakwalls and the entrance, upstream to the point that would cross a line drawn between the southernmost tip of Shark Island and the boat ramp at Mattys Flat. The methods most commonly applied by the estuary general fishery (meshing and trapping) are considered low risk activities. Recovery actions outlined by the plan include research activities, compliance activities and management activities.

### 12.1.2 Terrestrial Threatened Species

A number of threatened species under the *Threatened Species Conservation Act 1995* (TSC Act) and/or *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) have been recorded on or in proximity to the MREMP study area (Birch and GeoLINK 2010). The Large-footed Myotis (*Myotis macropus*), sometimes referred to as the Fishing Bat, is the main threatened terrestrial mammal that may directly utilise the Macleay estuary (at least in slow moving slightly brackish areas) as foraging habitat. DECCW (undated) describes the main threats to the Southern Myotis as:

- loss or disturbance of roosting sites – Actions for the protection and management of threatened species habitats on the MREMP study area that help mitigate against threats such as this, are discussed further in **Section 10**;
- clearing adjacent to foraging areas – Again actions for the protection and management of threatened species habitats on the MREMP study area that help mitigate against threats such as this, are discussed further in **Section 10**;
- application of pesticides in or adjacent to foraging areas – actions for the protection and management of threatened species habitats on the MREMP study area floodplain that help mitigate against threats such as this, are discussed further in **Section 10**; and
- reduction in stream water quality affecting food resources – Water quality issues relating to the Macleay estuary are discussed in **Section 13**.

The main threatened bird species that may use estuary habitats for foraging, roosting and/or nesting, and have been recorded within or in proximity to the Macleay estuary study area floodplain are listed below. These species are listed below along with their main known/potential uses of Macleay estuary:

- Black-necked Stork (*Ephippiorhynchus asiaticus*) – foraging habitat;
- Brolga (*Grus rubicunda*) – foraging habitat;
- Sooty Oystercatcher (*Haematopus fuliginosus*) – foraging habitat, though possibly roosting and nesting, particularly near the river mouth;
- Pied Oystercatcher (*Haematopus longirostris* ) – foraging, roosting and nesting habitat;
- Black Bittern (*Ixobrychus flavicollis*) – foraging, roosting and nesting habitat;
- Black-tailed Godwit (*Limosa limosa*) – non-breeding seasonal foraging and roosting habitat;
- Eastern Osprey (*Pandion cristatus*) – foraging habitat with habitats adjacent to the estuary providing roosting and nesting habitat;
- Little Tern (*Sterna albifrons*) - foraging, roosting and nesting habitat; and
- Beach Stone-curlew (*Esacus neglectus*) - foraging, roosting and nesting habitat.

A number of migratory species listed under the EPBC Act (some of which are dually listed as threatened under the TSC Act) have also been recorded within broader eastern KSC area as possibly utilising the Macleay estuary as foraging, roosting or nesting habitat. This includes (but is not limited to):

- Common Sandpiper (*Actitis hypoleucos*);
- Great Egret (*Ardea alba*);
- Cattle Egret (*Ardea ibis*);
- Ruddy Turnstone (*Arenaria interpres*);
- Sharp-tailed Sandpiper (*Calidris acuminata*);
- Sanderling (*Calidris alba*);
- Curlew Sandpiper (*Calidris ferruginea*);
- Red-necked Stint (*Calidris ruficollis*);
- Double-banded Plover (*Charadrius bicinctus*);
- Lesser Sand Plover (*Charadrius mongolus*);
- Grey-tailed Tattler (*Heteroscelus brevipes*);
- Broad-billed Sandpiper (*Limicola falcinellus*);
- Black-tailed Godwit (*Limosa limosa*);
- Eastern Curlew (*Numenius madagascariensis*);
- Whimbrel (*Numenius phaeopus*);
- Pacific Golden Plover (*Pluvialis fulva*);
- Little Tern (*Sterna albifrons*);

- Wood Sandpiper (*Tringa glareola*);
- Common Greenshank (*Tringa nebularia*); and
- Little Greenshank (*Tringa stagnatilis*).

The Macleay estuary may also provide potential habitat for a number of other migratory species (Birch and GeoLINK 2010).

Protection and management of migratory and threatened birds (particularly shorebirds) that may utilise the Macleay estuary as foraging, roosting or nesting habitat is a particular concern, as:

- protection of habitat alone for these species is not sufficient to collectively protect these species since they are vulnerable to threats such as human disturbance; fox, dog and cat predation; etc (Sandpiper Ecological Surveys 2009);
- the habitats for these species (included protected areas such as national parks and nature reserves) are often used intensely for recreation resulting in disturbance at foraging, roosting and nesting sites (Sandpiper Ecological Surveys 2009);
- the Macleay estuary is subject to intensive recreational usage in localised areas;
- other threats to these species such as predation are known to occur locally (fox, dog and cat predation – Birch and GeoLINK 2010);
- the Macleay estuary is one of the five large estuaries in the NRCMA area that provide the majority habitat for shorebird populations in the region; and
- shorebird data for the Macleay estuary is extremely limited (Sandpiper Ecological Surveys 2009).

## 12.2 Issues

The existing information about local populations of black cod and impacts upon them is not adequate for the description of any issues.

Similarly the limited information about the migratory and threatened bird usage of the Macleay estuary is insufficient to ensure species habitats are appropriately protected and managed.

## 12.3 Management Objectives

Based on the above issues, the estuary management study objectives for threatened species are:

| | |
|---|---|
| ***Management Objective 12/1*** | Increase the local population of Black Cod by providing ideal conditions for their growth and reproduction and minimising the risk of threats; |
| ***Management Objective 12/2*** | Protection and management of migratory and threatened birds (particularly shorebirds). |

## 12.4 Management Strategies

### 12.4.1 Encourage the participation of local diving groups in the collection of information about the local black cod population.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Engage local recreational diving clubs to conduct surveys of black cod in estuarine waters and to submit information about their distribution. | 12/1 | I&I, NRCMA |
| Engage local recreational diving clubs to monitor black cod at known sites in estuarine waters. | 12/1 | I&I, NRCMA |

### 12.4.2 Educate local recreational and professional fishers in identifying black cod, best practice release methods and gear types to reduce impacts on accidentally caught black cod.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Assess identification issues by encouraging the distribution of readily available material from NSW I&I among recreational fishing clubs. | 12/1 | I&I, NRCMA |
| Encourage local recreational fishers to record and report the location of black cod capture and the size and weight of the individual. | 12/1 | I&I, NRCMA |
| Use existing fishing clubs and to promote the use of fishing techniques and release methods that have the lowest risk of impact when such information becomes available. | 12/1 | I&I, NRCMA |

### 12.4.3 Protect Important Shorebird Sites

***Summary:*** This is a recommendation from the Sandpiper Ecological Surveys (2009) report which identifies and prioritises a range of recommendations for the management of shorebirds in the region. The aim of this strategy is to gather essential information to assist in identifying high conservation value habitats for shorebirds in the Macleay River estuary.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Undertake shorebird surveys in the Macleay Estuary to gather up-to-date information on population size, species richness and the distribution of roost and foraging areas | 12/2 | KSC, DECCW, NRCMA |
| Identify high conservation value habitat sites for shorebirds and prioritise for management | 12/2 | KSC, DECCW, NRCMA |
| Include shorebird habitat mapping, site prioritisation data and information on threats in Estuary Management Plans updates | 12/2 | KSC, DECCW, |
| Undertake further investigations at high priority sites to identify and prioritise threats at each site, and devise appropriate management actions and plan | 12/2 | KSC, DECCW, NRCMA |
| Adopt and implement management plans at high priority sites | 12/2 | KSC, DECCW, NRCMA |

## 13.1 Current Status

### 13.1.1 Summary of Available Information

Results from the general survey distributed as part of this study indicate that water quality is the most important issue concerning the community of estuary users. Good water quality was regarded as important or very important by 160 of the 162 respondents. The current water quality was rated as moderate by 44% of respondents and good or very good by 39%. Poor water quality after flooding ranked as the issue of greatest concern among those offered by the survey.


Source: LPMA (date of aerial photography: April 2009)

**Plate 13.1 'Blackwater' discharge from Belmore River following flood event in April 2009**

A variety of studies of water quality in the Macleay River estuary have been undertaken. The five main documents reviewed that assess water quality issues are:

- a summary of water quality monitoring programs for the entire Macleay River system prepared by Botting (2000);
- the Macleay River Estuary Data Compilation Study (Telfer 2005);

- an untitled report (Dutton 1999) describing the Macleay River Water Quality Monitoring project that has been operating since 1997 on the Belmore River, Kinchela Creek and Clybucca Creek.;
- the Macleay River Estuary Processes Study (WMA Water 2009); and
- a summary of water quality issues from major floodplain wetland areas in Tulau and Naylor (1999); and
- a rehabilitation plan for Gills Bridge Creek, South Kempsey prepared by Council (2007) and a subsequent stormwater management strategy for Gills Bridge Creek prepared by GeoLINK (2009).

Botting (2000) collated the water quality sampling information from the entire Macleay River and all of its subcatchments and assessed each dataset for its quality and the data itself against benchmarks set by the community. Of the many observations made, those relevant to the Macleay River estuary include:

- many of the programs are undertaken in the coastal catchments;
- dissolved oxygen (D.O.) concentration falls below desirable levels in most of the subcatchments of the Macleay River;
- problems with factors such as D.O., pH, turbidity, and phosphorus have been observed by many of the programs in the coastal catchments;
- a lack of aquatic ecology and environmental monitoring programs, despite the fact that such data provide the basis for sound management;
- aquatic weed build up and destruction of fish and oyster stocks are noted concerns within the community;
- the treatment and disposal of waste is a concern; and
- some parameters are missing from monitoring on the coastal Macleay subcatchment.

The Macleay River Estuary Data Compilation Study (Telfer 2005) described three issues which required further investigation. They were:

- arsenic and antimony enrichment of soils and surface water;
- the growth of aquatic weeds in the vicinity of Frederickton could be a result of excessive nutrient concentrations; and that
- tidal flushing times for different parts of the estuary were unknown at that point in time.

The Macleay River Water Quality Monitoring Project has collected a vast amount of information from critical sites across the Macleay floodplain. The data have been compiled up until 2004 but are yet to be analysed in a meaningful way as a whole data set. The project is in the process of finishing at the time of writing.

The Macleay River Estuary Processes Study (WMA Water 2009) included a 12 month survey of water quality in the estuary and subsequent comparison with historical information, an investigation into the effects of septic tank overflows on water quality in the Macleay Arm, a nutrient budget for the Macleay Estuary, an investigation of the bioavailability of arsenic and antimony in sediments and a summary of process interactions. It described the major factors impacting water quality in the Macleay estuary as:

- nutrient, metal and suspended sediment loads from the upper catchment;
- nutrient loads from urban runoff and wastewater treatment plants; and
- acidic and low dissolved oxygen runoff from the lower floodplain.

The following is a summary of their results:

- DO concentrations were generally normal except during one high flow event. Supersaturated $O_2$ concentrations were noted in areas of intense macrophyte growth and in one case attributed to concentrated phytoplankton production;
- sediment concentrations were found to be highest in the Macleay Arm and lower estuary. This was thought to be a result of wind resuspension;

- total Nitrogen concentrations above ANZECC (2000) guideline levels were observed during the summer months in the lower Macleay and Macleay Arm. It was proposed that these may have resulted from high levels of seagrass production since the primary form of nitrogen was Dissolved Organic Nitrogen. Total Nitrogen concentrations throughout the estuary spiked during heavy flow.
- the Concentration of nitrogen species (Ammonia, Nitrate, Nitrite) in many of the runs reflected phytoplankton uptake and that phytoplankton growth in the Macleay is generally nitrogen limited. Nitrate levels around the Gladstone STP occasionally exceeded ANZECC (2000) guideline levels.
- concentrations of the various Nitrogen species in the vicinity of the west and south Kempsey and Frederickton STPs were considered to be controlled by nutrient uptake of the large phytoplankton beds in that reach of the river.
- total Phosphorus concentrations tended to be higher at the seawater end of the estuary, reflecting a source in the lower estuary. Total Phosphorus concentrations spiked during a significant flow event.
- phosphorus concentrations were consistently highest in the Macleay Arm but most notably during the summer months. This may be associated with septic tank overflows or sediment resuspension.
- trends in Chlorophyll-a concentration reflected recurring phytoplankton blooms around the Gladstone STP in dry times and a delayed response to nutrient influxes associated with flooding. A phytoplankton bloom was observed in the upper Macleay Arm during the summer.
- chemical analyses of seagrass indicate that human sewage sources may impact water quality in the Macleay Arm.
- the development of a nutrient budget led to several interesting outcomes:
  - Benthic production dominated the overall productivity of the Macleay, indicating that management strategies should focus upon minimising turbidity, through control of the suspended sediment load and nutrient sources that encourage phytoplankton growth.
  - Benthic denitrification dominated the nitrogen outputs of the budget, drawing the same conclusion as the previous point.
- investigations into the bioavailability of arsenic and antimony showed that up to 29% of the arsenic and 16% of the antimony in sediment cores was leachable but that arsenic concentrations were less than the relevant guideline levels;
- The deposition of arsenic and antimony containing sediments onto floodplain environments during floods is also of concern. There is evidence that uptake of these metals by pastures is rapid and that continued deposition could lead to unacceptable levels in grazing animals.

Tulau and Naylor (1999) provide a comprehensive summary of water quality issues arising from the major Macleay River floodplain wetland areas. The key points made are as follows;

- *Yarrahapinni Wetlands* – Water quality degrades quickly following local rainfall. At these times dissolved oxygen reaches critical levels and pH is typically less than 5. Discharges from Yarrahapinni wetlands have been described as 'black, thick foul smelling soup'. The flushing conditions at the point of discharge into Andersons inlet are considered favourable and the permanent opening of one of the floodgates is likely to have improved the situation;
- *Collombatti/Clybucca Wetlands* – Toxic levels of acidity and aluminium have been recorded in the Seven Oaks Drain. A large number of fish kills have been recorded in Clybucca Creek over a long period of time. Flushing characteristics are moderately favourable;
- *Belmore Swamp* – A number of monitoring programs in the Belmore River have demonstrated that drainage of the swamp has often resulted in toxic levels of acidity and aluminium, in addition to the rapid deoxygenation of waters that can last for up to 3 weeks. Scotts Drain was identified in more than one study as having the lowest pH. Flushing and dilution conditions in the Belmore River are considered moderate and low respectively;
- *Frogmore Wetlands* – These wetlands drain into the Belmore River. Acidity in the Frogmore drainage systems has been linked to rainfall and demonstrated to be toxic to aquatic life. A major acidity event

was related to drain clearing activities in 1996. Flushing and dilution conditions are moderate and low respectively;

- *Kinchela Wetlands* – Drainage of these wetlands has resulted in the frequent acidification of Kinchela Creek and levels of iron and aluminium that are toxic to aquatic life. In addition, the inundation of pasture land has often resulted in the release of deoxygenated water into the creek. The flushing and dilution conditions are poor; and
- *Raffertys* – This area has not received much attention from water quality monitoring programs. Dilution conditions are considered favourable as the drain enters the Macleay River.

A stormwater management strategy prepared for the Gills Bridge Creek Rehabilitation Plan (GeoLINK, 2009) identified that East Kempsey Swamp plays a major role in reducing the catchment nutrient loads for Gills Bridge Creek, particularly the higher nutrient loading from the South Kempsey STP based on water quality monitoring results upstream and downstream of the wetland. The stormwater management strategy recommended protection of East Kempsey Swamp in view of the high treatment capacity of the wetland for nutrient loads from the South Kempsey STP.

### 13.1.2 Current Water Quality Monitoring Activities

There are three water quality monitoring programs currently operating within the study area. These are:

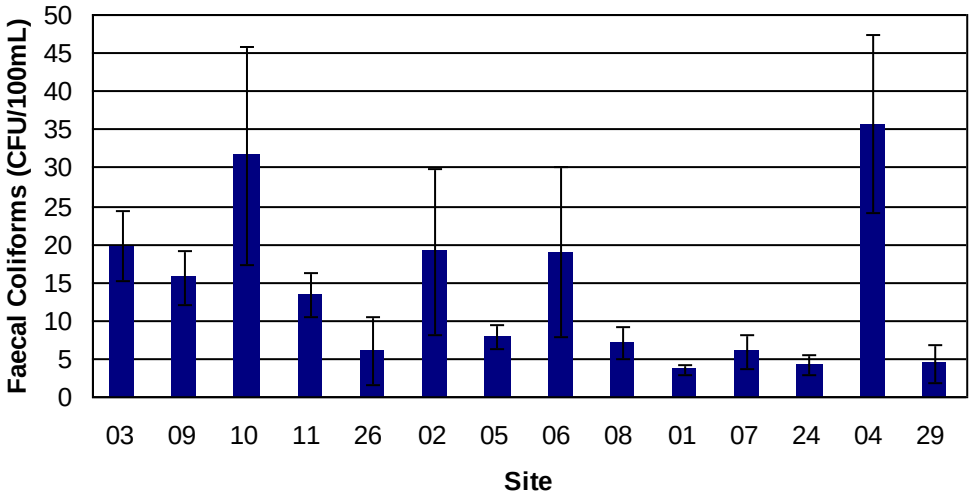
- the Beachwatch Program with samples taken at Stuarts Point and Back Creek . When these samples are collected physicochemical (pH, salinity, dissolved oxygen, turbidity and temperature) data are collected with a handheld probe;
- NSW DECCW sampling as part of the Statewide Monitoring, Evaluating and Reporting requirements. This program collects physicochemical information and measures chlorophyll-a concentrations and turbidity. The purpose of this monitoring is to create a broadly assessable measure of estuary health. This program is discussed further in **Section 16**; and
- the monitoring of water quality undertaken by oyster growers as part of the NSW Food Authority Shellfish Quality Assurance Program. This information is primarily bacteriological and allows growers to assess the risks with harvesting under varying weather conditions. A summary of results collected since 2003 is presented in **Table 13.1** and **Illustration 13.1.**

**Table 13.1 Summary of results from SQAP bacteriological water quality monitoring**

| *Harvest Area* | *Site* | *Average* | *SE* | *No.* | *80th %* |
|---|---|---|---|---|---|
| Clybucca Creek | 03 | 19.72263 | 4.523432 | 76 | 22 |
| | 09 | 15.59056 | 3.610994 | 71 | 17 |
| | 10 | 31.58264 | 14.18975 | 72 | 24 |
| | 11 | 13.26046 | 2.864163 | 65 | 18.4 |
| | 26 | 6.0575 | 4.41293 | 16 | 2 |
| Fishermans Reach | 02 | 18.99051 | 10.77514 | 59 | 10.4 |
| | 05 | 7.927857 | 1.548173 | 56 | 12 |
| | 06 | 18.92078 | 11.18174 | 90 | 9 |
| | 08 | 6.982623 | 2.106437 | 61 | 7 |
| New Entrance | 01 | 3.534063 | 0.615747 | 96 | 4 |
| | 07 | 5.91956 | 2.318033 | 91 | 4 |
| | 24 | 4.252308 | 1.357361 | 39 | 3.4 |

| Harvest Area | Site | Average | SE | No. | 80th % |
|---|---|---|---|---|---|
| Spencers Creek | 04 | 35.72438 | 11.70214 | 73 | 26.6 |
| Coopers Gutter | 29 | 4.33 | 2.406013 | 3 | 6.6 |

**Illustration 13.1 Average faecal coliform concentration (±SE) at SQAP monitoring sites.**




## 13.2 Issues

### 13.2.1 Recurring inputs of poor quality, acidic, deoxygenated water from drained wetland areas.

Inputs of acidic, deoxygenated water with elevated levels of iron and/or aluminium have been observed from almost all the major backswamp areas. These events are associated with catastrophic fish kills and are likely to result in devastating losses of invertebrate macrofauna. Management objectives and options targeting this issue are described in **Section 4**.

### 13.2.2 Elevated suspended sediment loads.

In times of heavy flow large volumes of sediment are delivered to the lower estuary. Some of the issues associated with this phenomenon include the smothering of valuable estuarine habitat and the loss of productive fishing grounds. Suspended sediments are also a vector for elevated nutrient levels in the estuary that can contribute to algal blooms.

### 13.2.3 Summer phytoplankton blooms in the Macleay Arm.

The causes of these blooms are not perfectly understood but may include diffuse nutrient loads and overflows from septic systems during heavy rainfall.

### 13.2.4 Phytoplankton blooms in the area around the Gladstone STP

Elevated chlorophyll a concentrations in the vicinity of the discharge point from Gladstone STP persist throughout the year. They are most likely related to the nutrient inputs associated with discharge. At this point in time the Gladstone STP can cater for 1000EP. It has no licensing requirements that limit nitrogen or phosphorus concentrations in discharged effluent. The Gladstone STP does not have facilities for phosphorus or nitrogen removal.

### 13.2.5 Elevated nutrient inputs may be resulting in the excessive growth of aquatic weeds in the vicinity of Christmas Creek/Frederickton.

It appears that the beds primarily made up of *Egeria densa* in this stretch of the river are subject to frequent variation in their distribution and density depending on flow and meteorological factors. However, the rapid growth noted under low flow conditions may be aided by the input of elevated nutrient levels from effluent inputs from Frederickton and West Kempsey STPs. In dry times, effluent discharge may be responsible for up to 44% of the nutrient input into the system (WMA Water 2009). West Kempsey STP, the largest in the study area, is licensed for 12000 EP. Effluent from West Kempsey STP is treated for phosphorus removal but not treated specifically for lowering the concentration of nitrogen in discharged effluent. In the past, West Kempsey STP had a constructed wetland-type shallow pond with rushes that were grown and harvested to reduce nutrients in the effluent. This has since been modified to cater for an alternative treatment method. West Kempsey treatment ponds are covered in duckweeds (possibly *Lemna* or *Azolla spp*.) during the colder months of the year. It is considered likely that this results in some nutrient removal prior to discharge. Frederickton STP is licensed for 1000EP and has no licensing requirements or specific equipment for targeted nutrient removal, aside from treatment lagoons.

#### 13.2.6 Potential Source of Dissolved Inorganic Phosphorus in the lower estuary.

This issue requires further investigation.

#### 13.2.7 Possible contamination of oyster aquaculture areas from primitive campsite arrangements with no sanitary facilities

A popular informal campsite located close to the most productive oyster aquaculture area on the Macleay has been identified as a potential source of contamination.

#### 13.2.8 Persistent poor water quality in the Belmore River and Kinchela Creek due to slow flushing times.

Belmore River and Kinchela Creek are particularly sensitive to the negative impacts of poor export water quality from backswamps due to their relatively small catchments and limited tidal regimes. These issues are directly related to the discharge of floodwaters retained on these sites by flood mitigation techniques. Management objectives and options targeting these issues are described in **Section 4**.

## 13.3 Management Objectives

Based on the above issues, the estuary management study objectives for threatened species are:

| | |
|---|---|
| ***Management Objective 13/1*** | To improve the general water quality of the Macleay River estuary with particular emphasis on chlorophyll a and suspended sediment concentrations; |
| ***Management Objective 13/2*** | To reduce the occurrence of acidic, deoxygenated black water discharge from backswamps. Management strategies for this objective are described in **Section 4**; |
| ***Management Objective 13/3*** | To reduce the nutrient load from Sewage Treatment Plants and from diffuse sources such as urban and agricultural land; |
| ***Management Objective 13/4*** | To reduce the sediment load from diffuse sources and erosion across the catchment; |
| ***Management Objective 13/5*** | To develop a consistent water quality monitoring program that adds to the understanding of the health of the system and is in line with DECCW MER sampling and NRCMA programs. The management strategies relevant to this objective are described in **Section 16**; |

## 13.4 Management Strategies

### 13.4.1 Reduce the nutrient content of effluent discharged into the Macleay estuary

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Undertake a cost benefit analysis of the potential reductions in nutrient concentrations of effluent under all potential upgrade scenarios for West Kempsey STP. This should include an assessment of a complete overhaul of the plant, which is ageing. | 13/1<br>13/3 | KSC |
| If deemed sufficiently beneficial, upgrade West Kempsey STP to include an enhanced form of nutrient removal. | 13/1<br>13/3 | KSC |
| Investigate the nitrogen and phosphorus discharge for the Frederickton and Gladstone STPs. | 13/1<br>13/3 | KSC / DECCW |
| If the nutrient levels of the discharged effluent are considered significant, assess the costs and benefits associated with upgrading the plants to include enhanced nutrient removal processes. | 13/1<br>13/3 | KSC |
| If deemed sufficiently beneficial, upgrade Gladstone and/or Frederickton STPs to include an enhanced form of nutrient removal. | 13/1<br>13/3 | KSC / DECCW |
| Investigate options for protection of East Kempsey Swamp due to its major role in reducing the catchment nutrient loads for Gills Bridge Creek, particularly the higher nutrient loading from the South Kempsey STP. | 13/1<br>13/3 | KSC |

### 13.4.2 Continue to revegetate the riparian zone and to address erosion across the catchment.

Section 3 of this report describes a detailed approach to this management option.

### 13.4.3 Investigate the impacts of nutrient and bacteriological pollution on the Macleay Arm

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Using the work of Laegdsgaard (2002) and WMA Water (2009) as a base, implement a study to define the risk posed to the critical habitats of the Macleay Arm by groundwater interaction, licensed point source inputs and diffuse source pollution from Stuarts Point, Grassy Head and Fishermans Reach. | 13/1<br>13/3<br>13/4 | DECCW, I&I, KSC |
| If deemed necessary, investigate alternatives to current arrangements for sewage treatment and disposal and the management of runoff. | 13/3 | KSC |

### 13.4.4 Develop and undertake a water quality public education program.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Develop and distribute material that can be used to educate the public in relation to the effects of diffuse pollutant loads on estuarine systems, the role of riparian buffers in reducing diffuse loads of sediment and nutrient pollution and erosion management techniques. As the vast majority of riparian land along the Macleay estuary is used to graze cattle this material should specifically target landholders. | 13/1<br>13/4 | DECCW, KSC. |
| Educate the users of 'primitive' campsites about the potential for contamination of adjacent oyster growing areas. Educate users about best practice waste disposal to avoid contamination of oyster growing areas. The best strategy to achieve this would be to erect an appropriate sign. | 13/1 | KSC, NSWSQAP |

### 13.4.5 Implement sediment and erosion control measures for key unsealed roads.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Identify public unsealed roadways in close proximity to watercourses | 13/1<br>13/4 | KSC. |
| Inspect above roadways to identify appropriate sediment controls if required to prevent sediment runoff to adjoining watercourses | 13/1<br>13/4 | KSC |
| Implement sediment controls where required on a priority basis in respect to potential reductions in sediment load to the watercourses | 13/1<br>13/4 | KSC |

# 14 Climate Change

## 14.1 Current Status

Climate change has the potential to impact on estuary processes in many and varied ways including sea level rise, water temperature increase, and deviations from present patterns of rainfall, wind, and water circulation. Due to limited understanding of many of these factors, the focus of climate change in this EMS is on the impacts of sea level rise which has the potential to impact on infrastructure, foreshore areas, and the low-lying floodplain areas, backswamps and drain management systems.

### 14.1.1 NSW Government Policy

In October of 2009 the NSW State Government released a policy statement (NSW Government, 2009a) which outlines the NSW Government's objectives and commitments in regard to sea level rise adaptation.

Sea level rise is an incremental process and will have medium to long term impacts. The best national and international projections of sea level rise along the NSW coast are for a rise relative to 1990 mean sea levels of 0.4 m by 2050 and 0.9 m by 2100. However, the Intergovernmental Panel on Climate Change (IPCC) in 2007 also acknowledged that higher rates of sea level rise are possible (NSW Government, 2009a:1).

The NSW Government promotes an adaptive, risk-based approach to managing the impacts of sea level rise. To support this approach and provide a consistent consideration of sea level rise, the NSW Government has adopted sea level rise planning benchmarks of an increase above 1990 mean sea levels of 0.4 m by 2050 and 0.9 m by 2100. These benchmarks will be reviewed periodically by the NSW Government with the next review likely to coincide with the release of the fifth IPCC report, due in 2014.

Other NSW Government guidelines include the *Draft Flood Risk Management Guide* (NSW Government, 2009b) and the *Draft Coastal Risk Management Guide* (NSW Government, 2009c) which include the above sea level rise benchmarks into the risk assessments for flooding and coastal hazards.

## 14.2 Issues

There is a range of potential impacts associated with sea level rise. General predictions include salt water intrusion into aquifers and estuaries, affecting coastal ecosystems, water resources and human settlements. Changes in drainage and groundwater levels, particularly on low lying floodplain areas may result in increased flood retention times, increased soil waterlogging and saline intrusion into groundwater drinking resources. This will have a significant impact on floodplain wetlands and agricultural practices on the Macleay floodplain. Many of the floodplain wetlands areas have an elevation approximately equal to current mean sea level.

There will be changes in the distribution and extent of coastal wetlands, impacting upon agriculture and low lying urban settlements. There will be changed flushing behaviour of estuaries and changes to current sediment patterns. Coastal impacts are likely to be shoreline recession and realignment of beaches.

The following sea level rise related issues will require consideration for future planning:

- **Coastal erosion and shoreline realignment:**
  Rising sea levels, increased frequency and severity of storms and changes in wave direction and wind

patterns have the potential to change shoreline profiles and barrier dune position and height. This could have significant impacts on the barrier dune system separating Macleay Arm from the sea and subsequently impacting the villages of Stuarts Point and Fishermans Reach. However, the *Stuarts Point Coastline Hazard Advice* (2000) (cited in Telfer, 2005) evaluated coastline hazards in the vicinity of Stuarts Point including long-term recession and climatic change. The evaluation concludes that the area is not subject to long-term recession (Telfer, 2005).
Changes to shoreline profiles and realignment of beaches will also impact on river entrance behaviour of the Macleay River and Back Creek.

- **Flushing behaviour and sediment patterns:**
  Changes to flushing behaviour, altered flood regimes associated with increased severity of rainfall, and increases in sea level will change current sediment patterns. Preliminary modelling by WMAwater (2009) indicates that peak tidal flows will increase as a result of sea level rise. Peak tidal flows will increase between 8% and 36% at the river entrance, with slightly larger increases experienced in the Macleay Arm which will impact on the shoaling patterns. The peak tidal flows associated with the outgoing tide will increase by up to 80% at Kempsey;
- **Impacts on Boating Infrastructure:**
  Higher river levels will need to be accommodated in boating facilities such as moorings, boat ramps, and associated recreational areas;
- **Bank erosion impacts from altered flood behaviour:**
  Flooding is the dominant erosive action for many of the bank erosion locations in the fluvial and transitional process zones. More intense rainfall associated with climate change (the intensity of a daily rainfall event may increase by 5% to 10% within the region) may result in more severe or more frequent flood events resulting in increased bank erosion;
- **Rising water levels in floodplain wetlands:**
  Sea level rise is likely to increase water levels in floodplain wetlands in conjunction with increased water levels in connecting watercourses and rising groundwater levels;
- **Floodplain drainage systems:**
  Higher water levels will be experienced in the drainage systems. The operation of the drainage system for flood mitigation will need to account for increased water levels and changes to rainfall intensities;
- **Groundwater resources:**
  There may be some impacts on private bores from saline intrusion into groundwater levels; and
- **Inundation of low lying areas:**
  Increased water levels from sea level rise in combination with flood levels may impact on some of the low-lying village areas, rural residences, and flood refuge areas for stock.

## 14.3 Management Objectives

Based on the above issues, the estuary management study objectives for climate change are:

| | |
|---|---|
| ***Management Objective 14/1*** | acknowledge the implications of sea level rise and climate change within the landuse planning framework; and; |
| ***Management Objective 14/2*** | plan for appropriate landuse of floodplain and backswamps which are more susceptible to changes associated with sea level rise. |

## 14.4 Management Strategies

### 14.4.1 Incorporate Climate Change into Local Planning Framework

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Sea level rise planning benchmarks described in the NSW State Government policy statement (2009a) are to be included in Kempsey Shire Council's draft Local Environmental Plan and relevant Development Control Plans | 14/1 | KSC |
| Sea level rise planning benchmarks and other recommendations described in the *Draft Flood Risk Management Guide* (NSW Government, 2009b) are to be included in Kempsey Shire Council's floodplain management policy and associated studies | 14/1 | KSC |
| Sea level rise planning benchmarks described in the *Draft Coastal Risk Management Guide* (NSW Government, 2009c) are to be included in coastal hazard assessments and coastal management planning undertaken by Kempsey Shire Council | 14/1 | KSC |

### 14.4.2 Define At-Risk Areas

***Summary:*** To assist in determining the potential risks to lands, built infrastructure and natural assets under the sea level rise planning benchmarks, the following strategies are proposed:

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Utilise the Digital Elevation Model (DEM) in floodplain management studies to define 'at-risk' locations for both flood and non-flood scenarios. It is noted that the DEM will be supplied to Council in 2010 by LPMA from the LiDAR project. The studies are to utilise the NSW Government sea level rise planning benchmarks | 14/1 | KSC |
| Incorporate the 'at-risk' locations into Kempsey Shire Council's draft Local Environmental Plan and relevant Development Control Plans | 14/1<br>14/2 | KSC |

### 14.4.3 Floodplain Management Plan

***Summary:*** A Floodplain Risk Management Study and Plan is being prepared for the Lower Macleay River. This study can include assessment of the impacts of sea level rise and altered rainfall patterns.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Model the impacts of sea level rise and altered rainfall patterns on the operation of the Macleay Valley Flood Mitigation Scheme and associated infrastructure and develop strategies for adaptation | 14/1<br>14/2 | KSC |

### 14.4.4 Flushing Behaviour and Sediment Patterns

***Summary:*** **Section 8** of this EMS recommends developing an entrance management protocol for Back Creek and maintenance dredging protocol for Macleay Arm between Stuarts Point and Fishermans Reach to address navigation issues associated with sediment accretion. Sea level rise will impact on sediment patterns which need to be considered in the development of protocols addressing this issue.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Consider seal level rise in development of any entrance management or maintenance dredging protocols | 14/1 | KSC |

### 14.4.5 Boating Infrastructure

***Summary:*** Higher river levels will need to be accommodated in boating facilities such as moorings, boat ramps, and associated recreational areas.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Incorporate sea level rise considerations into the Marine Infrastructure Assessment and associated concept plans (to be undertaken as part of the Estuary Management Plan) | 14/1<br>14/2 | KSC, NSW Maritime |

### 14.4.6 Bank erosion impacts from altered flood behaviour

***Summary:*** Flooding is the dominant erosive action for many of the bank erosion locations in the fluvial and transitional process zones. More intense rainfall associated with climate change may result in more severe or more frequent flood events resulting in increased bank erosion:

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Periodically monitor bank erosion and update GIS layer to monitor any changes in erosion patterns and locations | 14/1 | KSC, LPMA and NSW Maritime |

### 14.4.7 Ecological Impacts

***Summary:*** This issue has been addressed in **Section 4** with recommendation to design and implement a long term ecological monitoring program to analyse changes in onsite ecology to provide information about the adaptive behaviour of these habitats under future sea level rise scenarios. Climate change considerations have also been factored into the assessment of priority habitats in the estuary.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Incorporate relevant climate change research into the long term ecological monitoring program discussed in **Section 4** of this EMS. This will include research such as the ARC Linkage project "Impacts of climate change on coastal floodplain wetland biogeochemistry and surface water quality" ". This project is being conducted over a 3-year period from 2008 to 2011. Project partners include Primary Industries, Richmond Valley Council, Northern Rivers CMA and Southern Cross University (Australian Government, 2008) | 14/1<br>14/2 | KSC, NRCMA, DECCW, I&I |

# 15 Heritage Issues

## 15.1 Current Status

Macleay River has been integral to both Aboriginal and European heritage within the valley. This section of the EMS has been prepared based on a desktop assessment aimed at providing background information on Aboriginal and European heritage associated with the Macleay River estuary. No specific issues are evident, however the history, heritage sites and items outlined below should be considered in management strategies in other areas, such as tourism.

### 15.1.1 Aboriginal Heritage

The Macleay River estuary study area is situated in the country of the Dhanggati and Gumbaynggir tribes and it is acknowledged as a sharing place for the two Aboriginal groups. A number of other tribal groups are likely to have visited the area for a range of cultural practices, including people from the Ngamba tribe. The Kempsey Local Aboriginal Land Council, the Nambucca Local Aboriginal Land Council, the Dhanggati Elders and the Gumbaynggir Elders represent the area.

The Macleay River valley contains many sites of Aboriginal significance indicating a long occupation of the area of up to 4000 years (Clybucca Historic Site Plan of Management 2007).

During early European settlement, Aboriginal communities were established on Pelican and Fattorini Islands.

The Clybucca Historical Site is listed on the Register of National Estate, reserved because it contains large estuarine Aboriginal midden complexes. The site was '*an important meeting and sharing place for the Gumbaynggir and Dunghutti nations, a rich source of food, and is part of a mythological and spiritual landscape with high cultural significance to present day Aboriginal people on the midnorth coast'* (Clybucca Historic Site Plan of Management, 2007). An Aboriginal Custodian Group was originally established in 2003 to provide guidance to NPWS in the management of Clybucca Historic Site. This group is now also involved in the management of Yarrahapinni Wetlands National Park. It comprises representatives from the Dhanggati and Gumbaynggir nations, and other local Aboriginal community members.

The Clybucca Historic Site Plan of Management lists the following outcomes in respect to Conservation of Aboriginal Cultural Heritage:

- Aboriginal sites and places are protected from damage by human activities and, where possible, by natural processes; and
- Aboriginal people are involved in management of the cultural values of the historic site.

### 15.1.2 European Heritage

European history of the Macleay River dates to exploration of the area in 1820. European settlement began in 1826. Early industry within the valley included cedar logging, sheep, beef and dairy cattle and maze farming.

A search of the heritage databases has been undertaken, and these database search results are attached at **Appendix F**.

The Draft Kempsey Shire Community-based Heritage Study provides a list of heritage sites within the Kempsey local government area. Twenty-five of these are located on or adjacent to the Macleay River, listed in **Table 15.1**. Of these, three are currently listed sites and the remaining 22 are recommended for future listing under the KSC Local Environmental Plan, the State Heritage Register, Register of National Estate, or a non-statutory Local Heritage Value listing.

**Table 15.1 Heritage Sites: listed and recommended for listing**

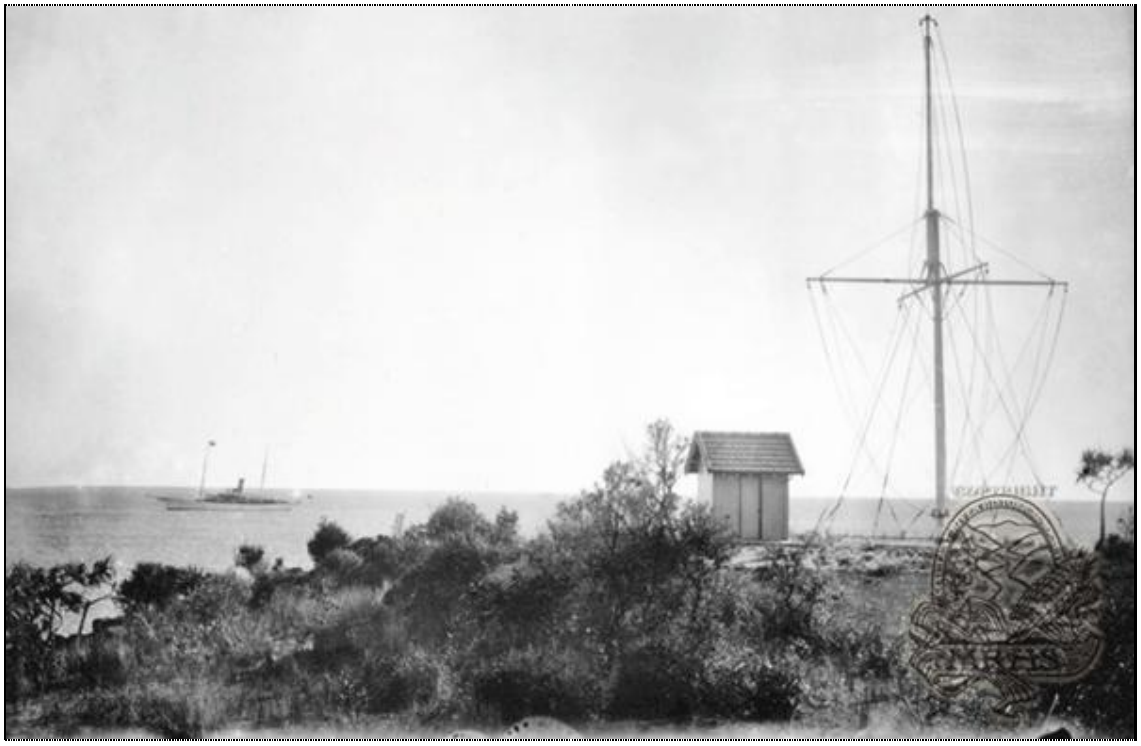
| *State Heritage Inventory No.* | *Listing Name* | *Location* | *Current Listing* | *Recommendation* | *Notes* |
|---|---|---|---|---|---|
| 1850107 | Boat Ramp and KSC Park | Macleay St, Frederickton | | **LEP, SHR** | |
| 1850275 | Riverside Memorial Park (including | Kinchela St, Gladstone / Smithtown | | **LEP, SHR** | |
| 1850127 | Kempsey Rail bridge over Macleay River | West Kempsey | SHR | **LEP, SHR** | |
| 1850365 | Bunya Pines Reserve | Bunya Pines Estate, West Kempsey | | **LEP** | |
| 1850052 | Pilots Residence and Boatman's Cottage; Pilot's residence, 3 boatman's' cottages | 3-9 Ocean Dr, South West Rocks | LEP, REP, RNE | LEP, REP, RNE, SHR | This is the Pilot's Residence area group |
| 1850069 | Signal Station and Flagstaff | Point Briner, Arakoon | LEP for flagstaff | **LEP for both, SHR** | |
| | Pilot Cottage Stairs | Off O'Keefe Rd, South West Rocks | | **LHV; signage requested** | |
| | Boat Shed (site only) | New Entrance, South West Rocks | | **LHV; signage requested** | |
| | Boat Ramp and Boat Shed site | New Entrance, South West Rocks | | **LHV; signage requested** | |
| 1850435 | Pillar remains of old bridge (site only) | South West Rocks | | **LHV; signage requested** | |
| 1850436 | Boat Shed | Gordon Young Dr (relocated) South West Rocks | | **LHV; signage requested** | Now Naval Cadets building |
| 1850437 | Coal wharf (site only) | New Entrance, South West Rocks | | **LHV; signage requested** | Site Only |

| *State Heritage Inventory No.* | *Listing Name* | *Location* | *Current Listing* | *Recommendation* | *Notes* |
|---|---|---|---|---|---|
| 1850438 | Wharf sites; Ferry wharf Log wharf Dry Dock | Ferry St end, River bank, Lord St, East Kempsey | | **LHV; signage requested** | |
| | Kempsey Traffic Bridge | East Kempsey | | | |
| 1850381 | East Kempsey | Cnr Bloomfield, East Kempsey | | **LEP** | |
| 1850439 | Loftus Bridge | Belmore River | | **LHV; signage requested** | |
| 1850441 | Wharf site below Razorback | Grassy Head | | **LHV; signage requested** | |
| 1850442 | Grassy Head walk | Grassy Head to Stuarts Point | | **LHV; signage requested** | |
| 1850447 | Jerseyville Wharf | Main St, Jerseyville | | **LHV; signage requested** | Located on riverfront |
| 1850448 | Fishing Fleet tie-off | Main St, Jerseyville | | **LHV; signage requested** | Located on riverfront |
| 1850450 | Spencers Creek Bridge | Over Spencers Creek, Jerseyville | | **LHV; signage requested** | |
| 1850056 | Kundabung Wharf | Pipers Creek, Kundabung | | **LEP** | |
| 1850452 | Ships wharf (site only) | Stuarts Point | | **LHV; signage requested** | Site Only |
| 1850453 | Ballast rocks | Stuarts Point | | **LHV; signage requested** | Site Only |
| 1850456 | Stuarts Point Reserve | Stuarts Point | | **LHV; signage requested** | |

Source: Draft Kempsey Shire Community-Based Heritage Study, KSC, 2005

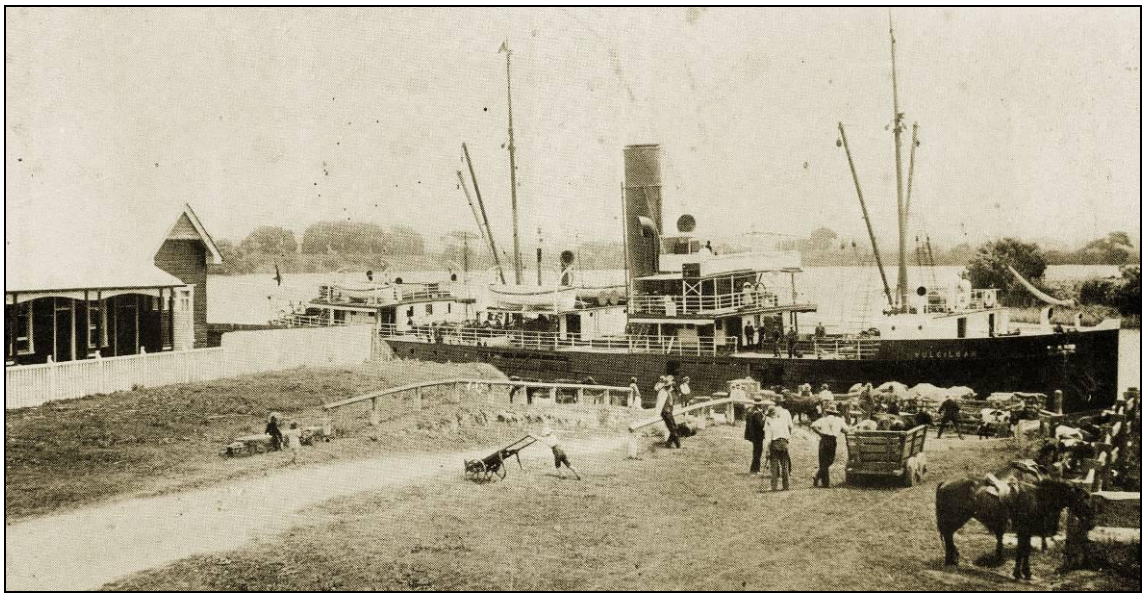
Grassy Head is one of the most important heritage areas in the Kempsey Shire and it has been recommended for further consideration for higher status listing. However, until this occurs, the importance of this area is noted. Grassy Head was the site of one of the first Pilot Stations on the coast of NSW, at the entrance to the Macleay River. The Pilot Station was set up in 1862. The main mast was on the headland to the north. Razorback, which is a ridge above Millington Avenue, carried a second mast to guide ships

in the river. The second mast and a beacon were guides for shipping entering and leaving the river. The course of the river did not allow ships entering the river to see a ship sailing down river so a second mast was necessary. Stone steps were cut into the rock face to enable the crew to reach the mast and beacon. These steps are still intact at the end of Millington Avenue. There are the remains of an old wharf under Razorback, which may have been where the pilot's crew launched their boats. The Pilot Station with the pilot residence and boatmen's cottages were located on the flat between Razorback and the headland, probably took in Millington Avenue. A walking trail has been made from Stuarts Point to Grassy head and ends at the stone steps. (Draft Kempsey Shire Community-Based Heritage Study, KSC, 2005)



Source: KSC: http://www.kempsey.nsw.gov.au/

**Plate 15.1 Grassy Head Pilot Station, circa 1900**



Source: KSC: http://www.kempsey.nsw.gov.au/

**Plate 15.2 Gladstone Wharf, early 20th Century**

## 15.2 Issues

There are no significant estuary management based heritage issues.

## 15.3 Management Objectives

The estuary management study objective for heritage is:

***Management Objective 15/1*** ensure relevant estuary management strategies do not conflict with objectives of the Draft Kempsey Shire Community-based Heritage Study and local issues of Aboriginal heritage and European heritage.

## 15.4 Management Strategies

### 15.4.1 Incorporate heritage strategies into any redevelopment works of the Riverside Park boat ramp facilities at Kempsey

***Summary:*** The Marine Infrastructure Assessment is assessing potential redevelopment works for the Riverside Park boat ramp facilities at Kempsey. There are potential synergies at this site with recommended actions in the Macleay Valley Coast Tourism Strategic Plan January 2005 – December 2009. *Action 24* of the Macleay Valley Coast Tourism Strategic Plan involves preparing heritage precinct plans for Kempsey, *Action 67* involves assessing the potential for riverine boardwalk, riverside event area adjacent to the Macleay River in Central Kempsey.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| The design of any redevelopment works of the Riverside Park boat ramp facilities at Kempsey should include consultation with Cultural Planning Advisory Committee, Macleay River Historical Society, Arts Mid North Coast, Macleay Valley Arts Council, and Australia's Holiday Coast Area Consultative Committee, in respect to Actions 24 and 67 of the Macleay Valley Coast Tourism Strategic Plan January 2005 – December 2009. | 15/1 | NSW Maritime, KSC |

### 15.4.2 Incorporate heritage strategies into any redevelopment works of historical boating infrastructure

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Any redevelopment of historical boating infrastructure consider the objectives of the Draft Kempsey Shire Community-based Heritage Study and the heritage precinct plans proposed in the Macleay Valley Coast Tourism Strategic Plan January 2005 – December 2009 | 14/1 | NSW Maritime, KSC |

# 16 Estuary Health

## 16.1 Current Status

### 16.1.1 Measuring Estuary Health

There are many plausible interpretations of what constitutes a healthy natural system. Definitions of the concept include;

- 'the ability to support and maintain a balanced, integrative, adaptive community of organisms having a species composition, diversity and functional organisation as comparable as practicable to that of natural habitats of the region' (Deely & Paling 1999);
- 'the maintenance of the structural and functional attributes including natural variability and succession' (Cairns Jr 1993); and
- 'the absence of ecosystem distress system' (in Deely & Paling 1999).

Other definitions might include some measure of the beneficial uses or the recreational utility of the system and subsequent social and economic impact. For the purposes of this report the concept is defined in terms of the *ecological* health of the estuary.

Due to the inherent variability in the physio-chemical, geological and biological conditions of estuaries, measuring their health can be very difficult. No two estuaries are truly alike, limiting the utility of comparative measures of heath. It is, at least, clear that no single indicator is adequate for measuring the health of an estuary. In addition, analyses of certain indicators, such as benthic macrofauna and stable isotopes , can require very high levels of expenditure. Thus, whilst no definitive quantitative system exists for the measure of the health of an estuary, a number of physical and biological characteristics can be used qualitatively to give an indication. These are:

- water quality, using measures such as Chlorophyll a concentration, physicochemical characteristics and nutrient, pathogen and metal concentration. Water quality is a relative concept that depends on the desired use;
- sediment quality, using biological measures and chemical parameters;
- habitat extent, distribution, connectivity and quality;
- biotic indicators such as benthic invertebrate counts, fish assemblages, macroalgae, seagrass, shorebirds and hermit crabs;
- ecosystem integrity using indicators such as algal blooms, pest invasions and fish kills; and
- catchment attributes such as erosion, landuse, diffuse and direct inputs.

The measurement of the ecological health of an estuary is further complicated in a large system such as the Macleay River estuary which is made up of a large number of subsystems that vary greatly in their nature and the specific impacts upon them.

The above factors indicate that the concept of ecological health of estuaries is problematic. However, if applied with caution, it can be a useful metric for managing of an estuary. In addition, many of the measures of estuary ecosystem health will at least provide an indication of the robustness of the ecological systems upon which many industries and activities depend.

The NSW state government has adopted thirteen targets for the condition of natural resources. Pertaining to estuaries, the two most important targets are:

- by 2015 there is an improvement in the condition of important wetlands;
- the extent of those wetlands is maintained; and
- by 2015 there is an improvement in the condition of estuaries and coastal lake ecosystems.

The Northern Rivers Catchment Management Authority has also set targets for the improvement of the condition of the coastal zone (including estuarine waters) by 2016. In order to meet these criteria meaningful indicators for measuring the condition of estuaries are required.

### 16.1.2 Current programs for the measurement of estuary health

Two estuary health monitoring programs are operating within the NRCMA boundaries at present. These programs are run by DECCW and the NRCMA.

The DECCW aquatic sciences unit are undertaking a statewide monitoring program as part of its responsibilities with respect to Monitoring, Evaluating and Reporting (MER) set down by the Natural Resources Commission. This program includes the Macleay River estuary and the first data collected from the Macleay as part of this program are soon to be released. The DECCW program focuses on turbidity and Chlorophyll a concentration as the two most descriptive and easily measured water quality indicators of the ecological health of estuaries. In order to apply these data in a meaningful way DECCW used ANZECC (2000) protocols to develop a set of trigger values for estuaries dependent on the class of estuary. The relevant trigger values are reproduced in **Table 16.1**.

**Table 16.1 Estuary Water Quality Trigger Values**

| *Estuary Class* | *Salinity Range (mg/L)* | *Chlorophyll (μg/L) 80th%ile of Reference* | *Turbidity (NTU) 80th%ile of Reference* |
|---|---|---|---|
| River – low | >25 | 2.1 | 1.9 |
| River – mid | 10-25 | 2.2 | 1.9 |
| River - upper | <10 | 3.5 | 23.9* |

Physio-chemical data are also collected during DECCW monitoring and used to dictate the exact location of sampling activities. The benefits of this system are the relative ease and affordability of monitoring protocols and the simplicity of subsequent analyses. The drawback of this system is the spatial scale at which monitoring is being undertaken. In effect the aim of the monitoring are to provide information on a state wide scale and that may not provide the information required by more local monitoring agencies with the information they require for the efficient use of resources. A series of biological indicators have been chosen to be assessed by other agencies to contribute to MER requirements for estuaries. These include:

- Eutrophication:
  - microalgal abundance as phytoplankton chlorophylla; and
  - macroalgal abundance.
- Habitat availability:
  - extent of seagrass;
  - extent of mangroves; and
  - extent of saltmarsh.
- Fish assemblages:
  - species diversity and composition;
  - species abundance;
  - nursery function; and
  - trophic integrity.

The NRCMA Rivers Ecohealth program is in pilot phase with data being collected from the Bellinger River. No plan exists at present for collecting data from the Macleay River. The ecohealth program is a more comprehensive approach and results in the production of 'report cards' for entire river systems. The program aims to develop a standard set of indicators that can be applied across rivers. The following indicators are being applied;

- water quality (pH, temperature, turbidity, nutrients, dissolved oxygen, salinity). This is collected monthly;
- ecosystem Processes (chlorophyll-a and total suspended sediments). This information is collected monthly and contributes to DECCW MER requirements;
- biotic Indicators (macroinvertebrates collected twice yearly, fish assemblages collected once every three years and vegetation collected annually); and
- land Use Pressures.

A number of benefits are expected to result from a comprehensive and centrally managed program such as improved efficiency of resource use, improved information exchange and easier prioritisation of environmental programs.

### 16.1.3 Current ecological health of the Macleay River estuary

The general survey conducted as part of the current study generated the following results with respect to community perceptions of the health of the Macleay River estuary:

- water quality: 83% of respondents rated it as "moderate" to "very good" (44% indicated "moderate");
- fish populations / aquatic ecosystems: 45% rated it as "very poor" to "poor"; 36% "moderate" and 19% "good" to "very good";
- riverside vegetation: an even 'spread' with - 34% rated it as "very poor" to "poor"; 37% "moderate" and 28% "good" to "very good";
- bank stability: 40% rated it as "very poor" to "poor"; 40% "moderate" and 20% "good" to "very good";
- navigation: 28% rated it as "very poor" to "poor"; 40% "moderate" and 31% "good" to "very good";
- floodplain backswamps: 44% rated it as "very poor" to "poor"; 38% "moderate" and 18% "good" to "very good"; and
- oyster harvest areas: 18% rated it as "very poor" to "poor"; 59% "moderate" and 23% "good" to "very good".

The Macleay River Estuary Processes Study delivered a synthesis of water quality information and ecological information pertaining to the health of the Macleay estuary. They described the key water quality processes that regulate the health of the Macleay estuary during flood, flood recovery and dry times. Key points from their analysis are:

- the sediment processes during a flood depend on the magnitude of the event and during extreme floods can include the creation of aquatic habitat and an increase in nutrient availability. However, it also may mean temporary habitat loss, nest disturbance, changes to higher order ecology such as fish kills and temporary reductions in available DO;
- post flood, the health of the estuary is controlled by the settling out of sediment and the uptake of nutrients by pelagic microalgae as light conditions improve. This can result in algal blooms. The other major factor at this stage is dissolved oxygen availability which can be low due to organic matter decomposition and runoff of deoxygenated water from the floodplain; and
- during dry times, wastewater inputs can be the greatest source of nutrients to the system but the large macrophyte beds around Frederickton reduce the impact of this (potential algal blooms) through nutrient uptake. Benthic production that relies on light transmission through the water column is particularly important during this stage as a carbon source that supports the food web. Benthic denitrification during dry times is

also a major regulator of estuary health as a major nitrogen output. These critical benthic processes highlight the importance of maintaining low sediment concentrations and reducing the risk of algal blooms.

With respect to the ecological health of the Macleay estuary the following points were made:

- fish stocks indicate a robust ecology with relatively stable recent commercial catches and a rapid response of fish populations following flooding cited as key evidence; and
- the health of critical habitats such as seagrass and the overall health of the estuary as evident in benthic microalgal processes are dependent on the maintenance of low turbidity and low inputs of inorganic nutrients.

Other evidence of the health of the Macleay estuary has been collected opportunistically. Key items that have been raised throughout consultation or noted during fieldwork are:

- the recent loss of the majority of seagrass habitats from the main arm of the Macleay River and the lag (upper Spencers Creek); and
- the impact of floods on aquatic ecology due to the severe effects of acidic and deoxygenated water discharge causing fish kills, oyster mortality and, in all likelihood, severe losses in lower order fauna such as benthic macroinvertebrates and crustaceans.

## 16.2 Issues

### 16.2.1 Lack of understanding of the ecological health of the Macleay River.

With the exception of the understanding of benthic processes reported in the Macleay River Estuary Processes Study (WMA Water 2009) and the understanding of fish production gained from commercial fisheries records, information regarding the health of the Macleay system has to be collected from projects that have not been designed for this purpose.

### 16.2.2 Lack of a comprehensive monitoring program for the ecological health of the Macleay River estuary.

Monitoring of water quality on the Macleay River has been extensive but has operated on a piecemeal basis. Monitoring of biotic factors has also been extensive but has lacked the cohesion of an overall plan. The development and undertaking of a comprehensive monitoring program will require some investment but will result in some efficiency in the future investment of resources and improved inter-agency communication.

### 16.2.3 Impact of suspended sediment loads on estuary health.

The assembled information leads to the conclusion that the suspended sediment load is a primary regulator of the health of the Macleay estuary. Minimising suspended sediment loads is a system wide management priority.

### 16.2.4 Impact of chlorophyll a concentration on estuary health.

Increased pelagic microalgal production can negatively impact upon the health of the system. The key factors controlling algal blooms – nutrient inputs and water temperature – should be a management priority.

### 16.2.5 The impact of floodwater discharge from modified floodplain backswamps on estuary health

The impacts of this phenomenon are adequately discussed in **Section 4**. Management strategies and objectives relating to this impact are contained in that section.

## 16.3 Management Objectives

Based on the above issues, the estuary management study objectives for estuary health are:

| | |
|---|---|
| ***Management Objective 16/1*** | Develop and implement a comprehensive monitoring and reporting program to improve the understanding of the ecological health of the Macleay River estuary; |
| ***Management Objective 16/2*** | Continue sampling that contributes to the NSW MER reporting requirements; |
| ***Management Objective 16/3*** | Reduce suspended sediment loads (see **Section 13** for management strategies); and |
| ***Management Objective 16/4*** | Reduce nutrient loads (see **Section 13** for management strategies). |

## 16.4 Management Strategies

### 16.4.1 Design and implement a monitoring program that will provide essential information regarding the health of the Macleay River estuary.

| *Steps Required* | *Objectives Addressed* | *Key Responsibilities* |
|---|---|---|
| Design an appropriate monitoring system that meets the requirements of the state government MER and will provides valuable information about the status of estuary health. | 16/1 | A pilot system "Ecohealth" is being developed as part of the Macleay River ecology study in consultation with NRCMA and DECCW. |
| Monitor estuary health as per developed protocols. | 16/2 | Continued implementation will be a responsibility of KSC, DECCW and I&I. |
| Report upon the health of the system and review monitoring protocols as required. Reports should be made readily available to the general public. | 16/1<br>16/2 | KSC, DECCW and I&I. |

# 17 Management Priorities

## 17.1 Priorities for Management Objectives

**Table 17.1** overleaf shows the ranked management objectives developed in the previous sections in terms of their priority for management over the next five years. Five years is the expected planning timeframe for the Macleay River Estuary Management Plan before it undergoes review and adjustment. The ranking has been based on the scoring system below. The scoring attributed to each management option is shown in **Table 17.2**.

Priorities have been allocated to management objectives based on a matrix assessment that considers:

- the degree to which the management objectives will impact on estuary issues: (scoring: low = 1, moderate = 3, high = 5);
- timeframe over which the impacts are likely to occur: (scoring: short (< 3 years) = 1, medium (5-8 years) = 3, long (>10 years) = 5);
- extent of the estuary addressed by the management objective: (scoring: lower estuary = 1, middle estuary = 1, upper estuary = 1, whole estuary = 3);
- community rating of the issues addressed by the management objectives based finding from the community survey detailed in **Section 2**): (scoring: not important = 0, important = 3, very important = 5); and
- likely cost of effective implementation of the management objectives: (scoring: high cost = 1, moderate cost = 3, low cost = 5).

The ranked management objectives generally show that improved management of floodplain wetlands, floodgates and drains, and water quality improvements are the key management objectives for the Macleay River estuary.

## 17.2 Prioritised Estuary Management Strategies

**Table 17.3** lists the potential management strategies for addressing the ranked management objectives. Details of the potential management strategies are outlined in the previous sections. The potential management strategies will be further considered and developed in the next phase of the project – the Macleay River Estuary Management Plan. Development of the strategies will involve prioritising the strategies and detailing actions for implementation, estimated costs, responsibilities, funding sources and timeframes.

**Table 17.1 Ranked Estuary Management Objectives for 2011 to 2016**

| *Ranking* | *Estuary Management Objective* |
|---|---|
| 1 | Acknowledge sea level rise and climate change within the landuse planning framework |
| 2 | Improved export water quality from floodplain wetland areas |
| 3 | Coordinate and prioritise drainage projects |
| 4 | Pursue active water management of floodgates in non-flood periods |
| 5 | Conservation of representative areas of floodplain wetlands |
| 6 | Maximise opportunities for public access to the Macleay River from commercial areas and the public domain within riverside townships |
| 7 | Reduce the occurrence of black water discharge from floodplain wetlands |
| 8 | Investigate water management improvements in the Collombatti-Clybucca drainage scheme |
| 9 | Plan for appropriate landuse of floodplain and backswamps susceptible to sea level rise |
| 10 | Improved water retention in floodplain wetlands |
| 11 | Utilise best-practice erosion control, riparian management techniques and flood mit. works |
| 12 | Reconnect the built form and public domain of riverside townships with the Macleay River |
| 13 | Improve the fishery productivity of the Macleay River estuary system |
| 14 | Develop a clear floodgate management regime for flood and non-flood events |
| 15 | Manage Yarrahapinni floodgates in accordance with Yarrahapinni Wetlands National Park Plan of Management. |
| 16 | Protect and manage important habitat areas |
| 17 | Protect important riparian conservation areas where threatened by bank erosion, weed invasion, or land management practices |
| 18 | Manage recreational boat use in areas susceptible to boat wash erosion |
| 19 | Preparation of a strategic plan for the future management of floodplain wetlands |
| 20 | Improved boating access and infrastructure |
| 21 | Improve the condition and continuity of the riparian corridor |
| 22 | Reduce the incidence of fish kills and oyster mortality related to poor water quality from floodplain wetland areas |
| 23 | Clarify the protocol for oyster mortality events on the Macleay River |
| 24 | Improve the water quality in regard to chlorophyll a and suspended sediment |
| 25 | Reduce the sediment load from diffuse sources and erosion |
| 26 | Develop a water quality monitoring program in regard to estuary health |
| 27 | Identify high priority conservation value habitats |
| 28 | Protect existing public infrastructure threatened by bank erosion |
| 29 | Improved understanding of the connection between the floodplain wetlands and estuary health |
| 30 | Protect existing bank and riparian management works |
| 31 | Ensure EMS strategies do not conflict with heritage objectives |
| 32 | Consider commercial fisher needs in the planning approval process for boating infrastructure |
| 33 | Reduce nutrient loads from Sewage Treatment Plants and diffuse sources |
| 34 | Protect and manage migratory and threatened birds (particularly shorebirds). |
| 35 | Control of *Salvinia molesta* on wetlands and in drains; |
| 36 | Minimise sediment loads that impact upon estuarine habitat and reduce water quality |
| 37 | Improve community understanding of safety issues with crossing entrance bars |
| 38 | Increase the local population of black cod |
| 39 | Develop and implement a comprehensive monitoring and reporting program to improve the understanding of the ecological health of the Macleay River estuary; |
| 40 | Reduce the risk and eyesore associated with derelict oyster leases; |
| 41 | Continue sampling that contributes to the NSW MER reporting requirements; |
| 42 | Future pedestrian / cycle paths in the Macleay Arm area |
| 43 | Develop a maintenance dredging protocol to address boating navigation concerns in Macleay Arm and at Riverside Park at Kempsey |
| 44 | Develop an entrance management protocol for boating navigation at Back Creek entrance |

**Table 17.2 Estuary Management Objective Priority Scores for 2011 to 2016**

| No. | Management Objective | Impact on Estuary Issues | Timeframe of Objective | Extent of Estuary | Community Rating | Cost of Implementation | Priority Score | Priority Ranking |
|---|---|---|---|---|---|---|---|---|
| ***Riparian Management and Erosion*** | | | | | | | | |
| 3/1 | Protect existing public infrastructure threatened or vulnerable to bank erosion | Low | Medium-Long Term | Whole Estuary | Important | Moderate-High Cost | 13.8 | 28 |
| 3/2 | Protect important riparian conservation values where threatened by bank erosion, weed invasion, or land management practices | Low-Moderate | Medium-Long Term | Whole Estuary | Important | Moderate-High Cost | 14.8 | 17 |
| 3/3 | Protect existing bank and riparian management works | Low-Moderate | Medium-Long Term | Mid-Lower Estuary | Important | Moderate-High Cost | 13.6 | 30 |
| 3/4 | Utilise best-practice erosion control, riparian management techniques and flood mitigation works to improve overall estuary health | Low-Moderate | Medium-Long Term | Whole Estuary | Important | Moderate Cost | 15.6 | 11 |
| 3/5 | Improve the condition and continuity of the riparian corridor | Low-Moderate | Long Term | Whole Estuary | Important | High Cost | 14.6 | 21 |
| 3/6 | Manage recreational boat use in areas of high vulnerability / susceptibility to wave wash erosion | Low | Medium Term | Whole Estuary | Important | Low-Moderate Cost | 14.8 | 17 |
| ***Floodplain Wetlands*** | | | | | | | | |
| 4/1 | Preparation of a strategic plan for the future management of wetland areas; | Low-Moderate | Medium Term | Mid-Lower Estuary | Important | Low-Moderate Cost | 14.7 | 19 |
| 4/2 | Improved export water quality from floodplain wetland areas; | High | Long Term | Mid-Lower Estuary | Important | Moderate Cost | 18.7 | 2 |
| 4/3 | Adequate conservation of representative areas of floodplain wetlands and the management of conserved areas for ecological outcomes; | High | Long Term | Mid-Lower Estuary | Important | High Cost | 16.7 | 5 |
| 4/4 | Improve the understanding of the biological connection between the floodplain wetlands and the estuary and how it can be managed; | Low-Moderate | Medium Term | Mid-Lower Estuary | Important | Moderate Cost | 13.7 | 29 |
| 4/5 | Control of Salvinia molesta on wetlands and in drains; | Low | Medium | Mid-Lower | Important | Moderate Cost | 12.7 | 35 |

| No. | Management Objective | Impact on Estuary Issues | Timeframe of Objective | Extent of Estuary | Community Rating | Cost of Implementation | Priority Score | Priority Ranking |
|---|---|---|---|---|---|---|---|---|
| | | | Term | Estuary | | | | |
| 4/6 | Improved water retention. | Moderate | Medium-Long Term | Mid-Lower Estuary | Important | Moderate Cost | 15.7 | 10 |
| ***Acid Sulfate Soils / Floodgate and Drains Management*** | | | | | | | | |
| 6/1 | Coordinate and prioritise drainage projects to ensure consistency of direction; | Moderate | Medium-Long Term | Mid-Lower Estuary | Very Important | Low-Moderate Cost | 17.2 | 3 |
| 6/2 | Progress initial investigations into water management improvements in the Collombatti-Clybucca drainage scheme; | Moderate | Long Term | Mid-Lower Estuary | Very Important | Moderate-High Cost | 16.2 | 8 |
| 6/3 | Pursue active management of floodgates to achieve best outcomes in non-flood periods; | Moderate-High | Medium-Long Term | Mid-Lower Estuary | Very Important | Moderate Cost | 17.2 | 3 |
| 6/4 | Develop a clear floodgate management regime in both flood and non-flood events; | Low-Moderate | Medium Term | Mid-Lower Estuary | Very Important | Low-Moderate Cost | 15.2 | 14 |
| 6/5 | Manage Yarrahapinni floodgates in accordance with Yarrahapinni Wetlands National Park Plan of Management. | Low | Long Term | Lower Estuary | Very Important | Low-Moderate Cost | 15.2 | 14 |
| ***Boating*** | | | | | | | | |
| 7/1 | Improved boating access and infrastructure | Low-Moderate | Medium-Long Term | Whole Estuary | Important | Moderate-High Cost | 14.7 | 20 |
| ***Sedimentation and Dredging*** | | | | | | | | |
| 8/1 | Develop a protocol to address boating navigation concerns associated with sedimentation at Back Creek entrance including sedimentation between the Back Creek boat launching facilities and the entrance; | Low-Moderate | Short Term | Lower Estuary | Important | Moderate-High Cost | 9.1 | 44 |
| 8/2 | Develop a protocol to address boating navigation concerns associated with sedimentation in Macleay Arm (between Stuarts Point and Fishermans Reach) and at Riverside Park at Kempsey; and | Low-Moderate | Short-Medium Term | Lower and Upper Estuary | Important | Moderate-High Cost | 10.1 | 43 |
| 8/3 | Investigate measures to improve community | Low- | Short- | Lower | Important | Low-Moderate | 12.1 | 37 |

| No. | Management Objective | Impact on Estuary Issues | Timeframe of Objective | Extent of Estuary | Community Rating | Cost of Implementation | Priority Score | Priority Ranking |
|---|---|---|---|---|---|---|---|---|
| | understanding of safety issues associated with crossing entrance bars, in the context of prevailing coastal processes. | Moderate | Medium Term | Estuary | | Cost | | |
| ***Tourism*** | | | | | | | | |
| 9/1 | Maximise opportunities for public access to the Macleay River from commercial areas and the public domain within riverside townships | Low-Moderate | Long Term | Whole Estuary | Important | Moderate Cost | 16.4 | 6 |
| 9/2 | Reconnect the built form and public domain of riverside townships with the Macleay River | Low-Moderate | Long Term | Whole Estuary | Important | Moderate Cost | 15.4 | 12 |
| 9/3 | Future pedestrian / cycle paths in the Macleay Arm area | Low | Medium Term | Lower Estuary | Important | Moderate-High Cost | 10.4 | 42 |
| ***Habitat Protection*** | | | | | | | | |
| 10/1 | Identify high priority conservation value habitats; and | Low-Moderate | Medium Term | Mid-Lower Estuary | Important | Low-Moderate Cost | 14.2 | 27 |
| 10/2 | Protect and manage important habitat areas. | Moderate-High | Medium-Long Term | Mid-Lower Estuary | Important | Moderate-High Cost | 15.2 | 16 |
| ***Fishery Management*** | | | | | | | | |
| 11/1 | Improve the fishery productivity of the Macleay River estuary system; | Moderate | Medium-Long Term | Whole Estuary | Important | Moderate-High Cost | 15.3 | 13 |
| 11/2 | Minimise fine sediment loads that impact upon estuarine habitat, infill productive fishing holes and reduce water quality. The management strategies that relate to this objective are found in Section 13; | Low-Moderate | Medium-Long Term | Lower Estuary | Important | Moderate-High Cost | 12.3 | 36 |
| 11/3 | Reduce the incidence of fish kills and oyster mortality related to poor export water quality from floodplain wetland areas. The management strategies that relate to this objective are found in Section 4; | Moderate | Medium-Long Term | Mid-Lower Estuary | Important | Moderate-High Cost | 14.3 | 22 |
| 11/4 | Consider the needs of commercial fishers in the planning approval process for wharves, jetties and | Low-Moderate | Medium Term | Lower Estuary | Important | Low-Moderate Cost | 13.3 | 32 |

| No. | Management Objective | Impact on Estuary Issues | Timeframe of Objective | Extent of Estuary | Community Rating | Cost of Implementation | Priority Score | Priority Ranking |
|---|---|---|---|---|---|---|---|---|
| | pontoons; | | | | | | | |
| 11/5 | Reduce the risk and eyesore associated with derelict oyster leases; | Low | Medium Term | Lower Estuary | Important | Moderate Cost | 11.3 | 40 |
| 11/6 | Clarify the protocol for the reporting of and response to oyster mortality events on the Macleay River. | Moderate | Medium Term | Lower Estuary | Important | Low-Moderate Cost | 14.3 | 22 |
| ***Threatened Species*** | | | | | | | | |
| 12/1 | Increase the local population of black cod by providing ideal conditions for their growth and reproduction and minimising the risk of threats; | Low | Medium-Long Term | Lower Estuary | Important | Moderate Cost | 12.0 | 38 |
| 12/2 | Protection and management of migratory and threatened birds (particularly shorebirds). | Low-Moderate | Medium-Long Term | Mid-Lower Estuary | Important | Moderate-High Cost | 13.0 | 34 |
| ***Water Quality*** | | | | | | | | |
| 13/1 | To improve the general water quality of the Macleay River estuary with particular emphasis on chlorophyll a and suspended sediment concentrations; | Low-Moderate | Medium Term | Whole Estuary | Very Important | Moderate-High Cost | 14.2 | 24 |
| 13/2 | To reduce the occurrence of acidic deoxygenated black water discharge from backswamps. Management strategies for this objective are described in Section 4; | Moderate-High | Medium-Long Term | Mid-Lower Estuary | Very Important | Moderate-High Cost | 16.2 | 7 |
| 13/3 | To reduce the nutrient load from Sewage Treatment Plants and from diffuse sources such as urban and agricultural land; | Low-Moderate | Medium Term | Whole Estuary | Very Important | High Cost | 13.2 | 33 |
| 13/4 | To reduce the sediment load from diffuse sources and erosion across the catchment; | Low-Moderate | Medium Term | Whole Estuary | Very Important | Moderate-High Cost | 14.2 | 24 |
| 13/5 | To develop a consistent water quality monitoring program that adds to the understanding of the health of the system and is in line with DECCW MER sampling and NRCMA programs. The management strategies relevant to this objective are described in Section 14; | Low-Moderate | Short-Medium Term | Whole Estuary | Very Important | Moderate Cost | 14.2 | 24 |
| ***Climate Change*** | | | | | | | | |

| No. | Management Objective | Impact on Estuary Issues | Timeframe of Objective | Extent of Estuary | Community Rating | Cost of Implementation | Priority Score | Priority Ranking |
|---|---|---|---|---|---|---|---|---|
| 14/1 | Acknowledge the implications of sea level rise and climate change within the landuse planning framework; and; | High | Long Term | Whole Estuary | Not Important | Low Cost | 19.8 | 1 |
| 14/2 | Plan for appropriate landuse of floodplain and backswamps which are more susceptible to changes associated with sea level rise. | Moderate-High | Long Term | Mid-Lower Estuary | Not Important | Moderate Cost | 15.8 | 9 |
| ***Heritage*** | | | | | | | | |
| 15/1 | Ensure relevant estuary management strategies do not conflict with objectives of the Draft Kempsey Shire Community-based Heritage Study and local issues of Aboriginal heritage and European heritage. | Low | Medium Term | Whole Estuary | Important | Low-Moderate Cost | 13.4 | 31 |
| ***Estuary Health*** | | | | | | | | |
| 16/1 | Develop and implement a comprehensive monitoring and reporting program to improve the understanding of the ecological health of the Macleay River estuary; | Low-Moderate | Short-Medium Term | Whole Estuary | Important | Moderate-High Cost | 12.0 | 38 |
| 16/2 | Continue sampling that contributes to the NSW MER reporting requirements; | Low | Short-Medium Term | Whole Estuary | Important | Moderate-High Cost | 11.0 | 41 |

**Table 17.3 Potential Estuary Management Strategies to be considered in the Estuary Management Plan**

| *Strategy No. (Section No. in Report)* | *Prioritised Estuary Management Strategies* |
|---|---|
| ***1. Objective 14/1 - Acknowledge the implications of sea level rise and climate change within the landuse planning framework*** | |
| 14.4.1 | Incorporate climate change into Local Planning Framework |
| 14.4.2 | Define At-Risk Areas in relation to sea level rise |
| 14.4.3 | Incorporate climate change into Council's Floodplain Management Plan |
| ***2. Objective 4/2 - Improved export water quality from floodplain wetland areas*** | |
| 4.4.1 | Continue to encourage wetter pasture management in the Belmore Swamp |
| 4.4.2 | Investigate further changes to drainage infrastructure in the Belmore area that could increase water retention and reduce groundwater drawdown |
| 4.4.3 | Continue to improve the management of east Kinchela wetland for ecological values |
| 4.4.4 | Investigate further changes to drainage infrastructure in the Kinchela area that could increase water retention and reduce groundwater drawdown |
| 4.4.5 | Continue to encourage wetter pasture management in the west Kinchela Swamp |
| 4.4.6 | Reinitiate plans for improved management of the Gladstone drain |
| 4.4.7 | Complete the rehabilitation of the Yarrahapinni Wetlands from a degraded, closed brackish system to a healthy estuarine system |
| 4.4.8 | Investigate changes to the drainage infrastructure in the Clybucca/Collombatti area with the aim of improved export water quality |
| 4.4.9 | Continue to encourage the uptake of wetter pasture management techniques in the Clybucca/Collombatti area |
| 4.4.10 | Investigate the effects of changes to drains in the Raffertys area |
| 4.4.11 | Update Wetland Care Australia floodplain wetland maps to include Frogmore and Raffertys wetland areas |
| ***3. Objective 6/1 - Coordinate and prioritise drainage projects to ensure consistency of direction*** | |
| 6.6.1 | Coordinate and prioritise floodgate and drainage projects to ensure consistency of direction |
| ***4. Objective 6/3 - Pursue active management of floodgates to achieve best outcomes in non-flood periods*** | |
| 6.6.3 | Pursue active management of floodgates to achieve best outcomes in non-flood periods |
| ***5. Objective 4/3 - Adequate conservation of representative areas of floodplain wetlands and the management of conserved areas for ecological outcomes*** | |
| The following management strategies for this objective are listed previously under No.2 - Objective 4/2 | |
| 4.4.3 | Continue to improve the management of east Kinchela wetland for ecological values |

| *Strategy No. (Section No. in Report)* | *Prioritised Estuary Management Strategies* |
|---|---|
| 4.4.7 | Complete the rehabilitation of the Yarrahapinni Wetlands from a degraded, closed brackish system to a healthy estuarine system |
| 14.4.7 | Incorporate climate change considerations into long term ecological monitoring program for Yarrahapinni Wetlands |
| ***6. Objective 9/1 - Maximise opportunities for public access to the Macleay River from commercial areas and the public domain within riverside townships*** | |
| 9.4.1 | Investigate appropriate strategies to reconnect riverside townships with the Macleay River |
| ***7. Objective 13/2 - To reduce the occurrence of acidic, deoxygenated black water discharge from backswamps*** | |
| Management strategies for this objective are listed previously under No.2 - Objective 4/2 | |
| ***8. Objective 6/2 - Progress initial investigations into water management improvements in the Collombatti-Clybucca drainage scheme*** | |
| 6.6.2 | Progress initial investigations into water management improvements in the Collombatti-Clybucca drainage scheme |
| ***9. Objective 14/2 - Plan for appropriate landuse of floodplain and backswamps which are more susceptible to changes associated with sea level rise*** | |
| The following management strategies for this objective are listed previously under No.1 - Objective 14/2 | |
| ***10. Objective 4/6 - Improved water retention*** | |
| The following management strategies for this objective are listed previously under No.2 - Objective 4/2 | |
| 4.4.1 | Continue to encourage wetter pasture management in the Belmore Swamp |
| 4.4.2 | Investigate further changes to drainage infrastructure in the Belmore area that could increase water retention and reduce groundwater drawdown |
| 4.4.3 | Continue to improve the management of east Kinchela wetland for ecological values |
| 4.4.4 | Investigate further changes to drainage infrastructure in the Kinchela area that could increase water retention and reduce groundwater drawdown |
| 4.4.5 | Continue to encourage wetter pasture management in the west Kinchela Swamp |
| 4.4.6 | Reinitiate plans for improved management of the Gladstone drain |
| 4.4.8 | Investigate changes to the drainage infrastructure in the Clybucca/Collombatti area with the aim of improved export water quality |
| 4.4.9 | Continue to encourage the uptake of wetter pasture management techniques in the Clybucca/Collombatti area |
| ***11. Objective 3/4 - Utilise best-practice erosion control, riparian management techniques and flood mitigation works to improve overall estuary health*** | |
| 3.4.4 | Utilise best-practice erosion control, riparian management techniques and flood mitigation works |
| ***12. Objective 9/2 - Reconnect the built form and public domain of riverside townships with the Macleay River*** | |

| *Strategy No. (Section No. in Report)* | *Prioritised Estuary Management Strategies* |
|---|---|
| The following management strategies for this objective are listed previously under No.6 - Objective 9/1 | |
| 9.4.1 | Investigate appropriate strategies to reconnect riverside townships with the Macleay River |
| ***13. Objective 11/1 - Improve the fishery productivity of the Macleay River estuary system*** | |
| This objective is broadly addressed by previous floodplain wetland, drainage management and water quality strategies | |
| ***14. Objective 6/4 - Develop a clear floodgate management regime in both flood and non-flood events*** | |
| 6.6.4 | Develop a clear floodgate management regime in both flood and non-flood events |
| ***15. Objective 6/5 - Manage Yarrahapinni floodgates in accordance with Yarrahapinni Wetlands National Park Plan of Management*** | |
| 6.6.5 | Manage Yarrahapinni floodgates in accordance with Yarrahapinni Wetlands National Park Plan of Management |
| ***16. Objective 10/2 - Protect and manage important habitat areas*** | |
| 10.4.1 | Amend Council LEP Land Zoning to Protect Important Habitat |
| 10.4.2 | Encourage BioBanking of Important Habitat Areas |
| 10.4.3 | Encourage Landholder Management of Important Habitat Areas |
| 10.4.4 | Further Investigate the Possibility of Establishing a Aquatic Reserve in Yarrahappinni Wetlands National Park |
| ***17. Objective 3/2 - Protect important riparian conservation values where threatened by bank erosion, weed invasion, or land management practices*** | |
| 3.4.2 | Protect important riparian conservation values where threatened by bank erosion, weed invasion, or land management practices |
| 3.4.4 | Utilise best-practice erosion control, riparian management techniques and flood mitigation works |
| 14.4.6 | Monitor bank erosion and update GIS layer to monitor for changes in erosion patterns and locations associated with climate change impacts |
| ***18. Objective 3/6 - Manage recreational boat use in areas of high vulnerability / susceptibility to wave wash erosion*** | |
| 3.4.6 | Manage recreational boat use in areas of high vulnerability / susceptibility to wave wash erosion |
| 3.4.4 | Utilise best-practice erosion control, riparian management techniques and flood mitigation works |
| ***19. Objective 4/1 - Preparation of a strategic plan for the future management of wetland areas*** | |
| The following management strategies for this objective are listed previously under No.2 - Objective 4/2 | |
| 4.4.2 | Investigate further changes to drainage infrastructure in the Belmore area that could increase water retention and reduce groundwater drawdown |

| *Strategy No. (Section No. in Report)* | *Prioritised Estuary Management Strategies* |
|---|---|
| 4.4.4 | Investigate further changes to drainage infrastructure in the Kinchela area that could increase water retention and reduce groundwater drawdown |
| 4.4.6 | Reinitiate plans for improved management of the Gladstone drain |
| 4.4.7 | Complete the rehabilitation of the Yarrahapinni Wetlands from a degraded, closed brackish system to a healthy estuarine system |
| 4.4.8 | Investigate changes to the drainage infrastructure in the Clybucca/Collombatti area with the aim of improved export water quality |
| 4.4.10 | Investigate the effects of changes to drains in the Raffertys area |
| 4.4.11 | Update Wetland Care Australia floodplain wetland maps to include Frogmore and Raffertys wetland areas |
| ***20. Objective 7/1 - Improved boating access and infrastructure*** | |
| 7.4 | Adopt the recommendations of the Marine Infrastructure Assessment |
| 14.4.5 | Incorporate sea level rise considerations into the Marine Infrastructure Assessment and associated concept plans |
| 15.4.1 | Incorporate heritage strategies into any redevelopment works of the Riverside Park boat ramp facilities at Kempsey |
| 15.4.2 | Incorporate heritage strategies into any redevelopment works of historical boating infrastructure |
| ***21. Objective 3/5 - Improve the condition and continuity of the riparian corridor*** | |
| 3.4.5 | Improve the condition and continuity of the riparian corridor |
| 3.4.4 | Utilise best-practice erosion control, riparian management techniques and flood mitigation works |
| 14.4.6 | Monitor bank erosion and update GIS layer to monitor for changes in erosion patterns and locations associated with climate change impacts |
| ***22. Objective 11/3 - Reduce the incidence of fish kills and oyster mortality related to poor export water quality from floodplain wetland areas*** | |
| The management strategies that relate to this objective are listed previously under No.2 - Objective 4/2 | |
| ***23. Objective 11/6 - Clarify the protocol for the reporting of and response to oyster mortality events on the Macleay River*** | |
| 11.4.2 | Define clear protocols for the reporting on and responding to oyster mortality events |
| ***24. Objective 13/1 - To improve the general water quality of the Macleay River estuary with particular emphasis on chlorophyll a and suspended sediment concentrations*** | |
| 13.4.1 | Reduce the nutrient content of effluent discharged into the Macleay estuary |
| 13.4.3 | Investigate the impacts of nutrient and bacteriological pollution on the Macleay Arm |
| 13.4.4 | Develop and undertake a water quality public education program |
| 13.4.5 | Implement sediment and erosion control measures for key unsealed roads |

| *Strategy No. (Section No. in Report)* | *Prioritised Estuary Management Strategies* |
|---|---|
| ***25. Objective 13/4 - To reduce the sediment load from diffuse sources and erosion across the catchment*** | |
| The following management strategies for this objective are listed previously under No.22 - Objective 13/1 | |
| ***26. Objective 13/5 - To develop a consistent water quality monitoring program that adds to the understanding of the health of the system and is in line with DECCW MER sampling and NRCMA programs.*** | |
| The following management strategies for this objective are listed previously under No.24 - Objective 13/1 | |
| ***27. Objective 10/1 - Identify high priority conservation value habitats*** | |
| The management strategies that relate to this objective are listed previously under No.16 - Objective 10/2 | |
| ***28. Objective 3/1 - Protect existing public infrastructure threatened or vulnerable to bank erosion*** | |
| 3.4.1 | Protect Existing Public Infrastructure threatened or vulnerable to bank erosion |
| 3.4.4 | Utilise best-practice erosion control, riparian management techniques and flood mitigation works |
| 14.4.6 | Monitor bank erosion and update GIS layer to monitor for changes in erosion patterns and locations associated with climate change impacts |
| ***29. Objective 4/4 - Improve the understanding of the biological connection between the floodplain wetlands and the estuary and how it can be managed*** | |
| No strategy is currently proposed for this objective | |
| ***30. Objective 3/3 - Protect existing bank and riparian management works*** | |
| 3.4.3 | Protect existing bank and riparian management works |
| 3.4.4 | Utilise best-practice erosion control, riparian management techniques and flood mitigation works |
| 14.4.6 | Monitor bank erosion and update GIS layer to monitor for changes in erosion patterns and locations associated with climate change impacts |
| ***31. Objective 15/1 - ensure relevant estuary management strategies do not conflict with objectives of the Draft Kempsey Shire Community-based Heritage Study and local issues of Aboriginal heritage and European heritage*** | |
| The following management strategies for this objective are listed previously under No.20 - Objective 7/1 | |
| ***32. Objective 11/4 - Consider the needs of commercial fishers in the planning approval process for wharves, jetties and pontoons*** | |
| 11.4.1 | Incorporate commercial fishing requirements into the planning approvals process for wharves, jetties and pontoons |
| ***33. Objective 13/3 - To reduce the nutrient load from Sewage Treatment Plants and from diffuse sources such as urban and agricultural land*** | |
| The following management strategies for this objective are listed previously under No.24 - Objective 13/1 | |
| ***34. Objective 12/2 - Protection and management of migratory and threatened birds (particularly shorebirds)*** | |

| *Strategy No. (Section No. in Report)* | *Prioritised Estuary Management Strategies* |
|---|---|
| 12.4.3 | Protect Important Shorebird Sites |
| ***35. Objective 4/5 - Control of Salvinia molesta on wetlands and in drains*** | |
| The following management strategies for this objective are listed previously under No.2 - Objective 4/2 | |
| 4.4.3 | Continue to improve the management of east Kinchela wetland for ecological values |
| ***36. Objective 11/2 - Minimise fine sediment loads that impact upon estuarine habitat, infill productive fishing holes and reduce water quality. The management strategies that relate to this objective are found in Section 13*** | |
| The management strategies that relate to this objective are listed previously under No. 25 - Objective 13/4 | |
| ***37. Objective 8/3 - Improve Community Understanding of Safety Issues of Crossing Entrance Bars*** | |
| 8.4.3 | Investigate measures to improve community understanding of safety issues associated with crossing entrance bars, in the context of prevailing coastal processes |
| ***38. Objective 12/1 - Increase the local population of black cod by providing ideal conditions for their growth and reproduction and minimising the risk of threats*** | |
| 12.4.1 | Encourage the participation of local diving groups in the collection of information about the local black cod population |
| 12.4.2 | Educate local recreational and professional fishers in identifying black cod, best practice release methods and gear types to reduce impacts on accidentally caught black cod |
| ***39. Objective 16/1 - Develop and implement a comprehensive monitoring and reporting program to improve the understanding of the ecological health of the Macleay River estuary*** | |
| 16.4.1 | Design and implement a monitoring program that will provide essential information regarding the health of the Macleay River estuary |
| ***40. Objective 11/5 - Reduce the risk and eyesore associated with derelict oyster leases*** | |
| 11.4.3 | Clean up derelict oyster leases |
| ***41. Objective 16/2 - Continue sampling that contributes to the NSW MER reporting requirements*** | |
| The management strategies that relate to this objective are listed previously under No. 26 - Objective 13/5 | |
| ***42. Objective 9/1 - Future Pedestrian / Cycle Paths in the Macleay Arm Area*** | |
| 9.4.1 | Ensure recreation pedestrian / cycle paths in the Macleay Arm area are developed to complement the objectives of the Clybucca Historic Site and Yarrahapinni Wetlands National Park |
| ***43. Objective 8/2 - Develop a protocol to address boating navigation concerns associated with sedimentation in Macleay Arm (between Stuarts Point and Fishermans Reach) and at Riverside Park at Kempsey*** | |
| 8.4.2 | Develop a Maintenance Dredging Protocol for Macleay Arm and Riverside Park at Kempsey |
| 14.4.4 | Incorporate climate change considerations into entrance management protocol for Back Creek and maintenance dredging protocol for Macleay Arm |
| ***44. Objective 8/1 - Develop a protocol to address boating navigation concerns associated with sedimentation at Back Creek entrance including sedimentation between the Back Creek boat*** | |

| *Strategy No. (Section No. in Report)* | *Prioritised Estuary Management Strategies* |
|---|---|
| ***launching facilities and the entrance*** | |
| 8.4.1 | Develop an Entrance Management Protocol for Back Creek |
| 14.4.4 | Incorporate climate change considerations into entrance management protocol for Back Creek and maintenance dredging protocol for Macleay Arm |

# Project Team

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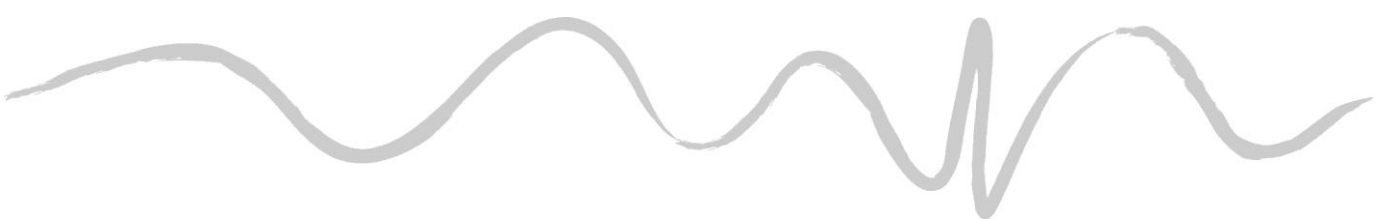
# Appendix A

## Marine Infrastructure Assessment

# Macleay River Estuary Management Plan

## Marine Infrastructure Assessment



# Macleay River Estuary Management Plan

## Marine Infrastructure Assessment

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# Executive Summary

Recreational boating forms a vital component of the tourism sector of the lower Macleay River Valley and is a significant lifestyle activity enjoyed by a large proportion of its residents. Many of the communities, particularly those in coastal areas, are very much reliant on tourism to drive their local economies.

Availability of suitable river access points and appropriate and complimentary marine infrastructure is critical to the enjoyment of recreation boating in the estuary. The quality of this infrastructure is key to attracting and retaining visitors to the communities along the Macleay River as destinations of choice.

This study was prepared to document and assess the range and quality of marine infrastructure as a basis for determining improved management strategies and possible infrastructure improvements over the long term. The study area included the lower river catchment as far as the tidal limit, some 10 kilometres west of Kempsey.

An important part of this process involved consultation with the boating fraternity and key stakeholders within the local community to identify usage patterns, issues, values and aspirations for change or improvement.

The study identified 18 public boat access points for assessment extending from Greenhill, west of Kempsey, Back Creek near South West Rocks in the east, and Stuarts Point in the upper reaches of the Macleay Arm to the north.

Kempsey Shire Council is also currently in negotiation with NSW Roads and Traffic Authority regarding the possibility of installing a new boat ramp to replace the existing facility at Frederickton. This may occur if a new levee is built around the town as part of the future Pacific Highway bypass. Given the uncertainty of the new ramp location, it has not been possible to undertake an assessment of the site as part of this study.

The outcomes of the site assessment revealed that the quality of boating access and complimentary on-shore support and recreational facilities varied considerably. Many access points have been established on former river punt approaches with little if any further site development. Other locations have been purpose designed and include a full range of infrastructure to cater to high carrying capacities. The assessment revealed that all of the sites required improvements if they were to offer an optimal level of service and facility suitable for their location.

Feedback from the consultation process highlighted significant user concerns along the estuary. Primary issues identified were:

- siltation and weed growth along foreshores preventing optimal water access and navigation at key locations and sections of the river;
- a general lack of adequate, safe launching facilities, particularly for short term mooring;
- a need for improved amenities to enhance riverside locations as a destination for family day use;
- potential to upgrade and expand facilities at particular sites which would off-set major issues associated with peak demand and conflicts between users;
- some concern for conflict between incompatible uses and their proximity to nearby residential areas; and
- conservation and natural values of the estuary which were highly regarded.

The outcomes of the site assessment and consultation phases were analysed to identify opportunities and constraints for improving boating access and infrastructure. This provided the basis for the following management objectives and guiding principles:

- to ensure the long term sustainability of recreational boating as a key driver of the local economy;
- to provide an equitable distribution and number of launching facilities within the lower Macleay area that reflects the diversity of usage patterns and demands;
- to provide a range of facilities and services that meets the expectations of the boating and wider community and that can be maintained at a high standard within the available resources of the local authority;
- to give contextual consideration to the provision of improved marine infrastructure at particular sites in order to optimise the potential benefits of nearby areas; and
- to ensure the ongoing use and management of marine infrastructure is environmentally sustainable.

A draft strategy was then developed to determine and guide the future implementation of improvements to boating access and infrastructure. This process involved the grouping of sites into the following three categories which reflected a recommended hierarchy of facilities and services that should be developed:

- primary boating and recreation nodes;
- secondary boating and recreation sites; and
- primitive launching sites.

Several sites were also identified where no development was warranted at this stage as they were least favoured for boating or recreational use.

Application of this hierarchy formed the basis of a detailed description of recommendations for each of the investigation sites within the study area. The descriptions included site specific measures that may also be desirable to optimise particular site opportunities.

Following input from a further round of community consultation, the draft strategies will be amended where necessary and developed further as part of the next stage of the project involving the preparation of the Macleay River Estuary Management Plan. This process will involve the identification of strategy priorities, detailed implementation actions, estimated costs, responsibilities, funding sources and timeframes. Concept plans for three key sites (Fishermans Reach Boat Ramp, Riverside Park Smithtown and Riverside Park Kempsey) will also be generated to demonstrate their design potential through the implementation of the recommended management strategies. A forth concept plan will be prepared for the Mattys Flat site which will be incorporated into the Draft Revised Mattys Flat Plan of Management.

# 1 Introduction

This report has been prepared by GeoLINK for Kempsey Shire Council, Department of Environment, Climate Change & Water and NSW Maritime to assess existing public infrastructure along the lower Macleay River Estuary. The assessment was undertaken as part of a broader study being the Estuary Management Study and Plan (EMP) for the Macleay River which was also prepared by GeoLINK in association with GECO Environmental and Aquatic Science and Management. Findings from the infrastructure assessment will form an integral and complementary component of the EMP.

## 1.1 Study Objectives and Methodology

The key purpose of the study is to provide a comprehensive understanding of the existing status of marine infrastructure within the Lower Macleay Estuary and to provide direction for sustainable management and a decision-making framework for undertaking asset improvements that meets community expectations and management capacity.

In order to achieve this outcome, the study undertook the following tasks:

- mapping of the locations of all current infrastructure facilities;
- a comprehensive community / user consultation process to identify recreational boating issues, needs and aspirations;
- an assessment of existing usage patterns, current and future demands, and environmental, economic and social effects on all existing maritime infrastructure;
- identification of key management issues;
- development of potential management strategies and site specific actions in response to issues;
- identification of responsibilities and funding methods for each action;
- development of an implementation sequence;
- preparation of concept plans for three key sites to demonstrate possible design solutions in response to strategies and actions; and
- preparation of a concept design for the Mattys Flat site as part of the Draft Revised Mattys Flat Plan of Management 2010.

## 1.2 Study Area

The study area encompasses the lower Macleay River Estuary including the waterways and tributaries up to the tidal limit, the entrance, foreshores, floodplain and adjacent land and coastline. Back Creek near the New Entrance at South West Rock is also included in the study area.

# 2 Background

## 2.1 Overview

The Macleay River estuary is a principal natural feature of the Kempsey Local Government Area and is one of its primary commercial and recreational assets.

As a large navigable system, the Macleay River estuary provides a wealth of opportunities for experienced and novice boaters alike. The natural amenity and ecological significance of many of its reaches combine with the holiday charm of its villages to create a prime tourist destination. The river is a key component of the local tourism industry which experiences 415,000 visitors spending an estimated $90 million per year.

The predominant boating use within the estuary is commercial and recreational fishing. Recreational boating, water skiing, and paddling are also popular activities. These compete with the limited access points and facilities that are dotted along the river foreshores.

Increasing user demand and expectations for improved access and facilities has impacted on the quality of boating experience within the estuary. The need to address these issues through a coordinated and strategically considered approach to planning for future boating facilities will be vital if the recreational and natural values of the river and the economic benefits from tourism are maintained.

## 2.2 Related Studies and Literature

The following reports and information were reviewed and interpreted to provide a basis and context for the preparation of the Marine Infrastructure Assessment :

- Data Compilation Report (GECO 2005);
- Processes Study (WMAwater, 2009);
- Draft Mattys Flat Draft Plan of Management, (Patterson Britton & Partners 2006, Revised Kempsey Shire Council 2010) ;
- GIS data base, Kempsey Shire Council ; and
- NSW Public Boat Ramps data base, NSW Maritime.

# 3

# Marine Infrastructure Assessment

## 3.1 Overview

A detailed assessment of boating infrastructure and access ramps was undertaken on 18 sites along the lower Macleay River (refer to **Illustration 3.1**). The sites were identified from an existing register of public infrastructure along the river provided by Kempsey Shire Council. The value of these sites for the purpose of this study was confirmed by NSW Maritime.

The selection of sites was limited to those located on and accessible by public land. There are also numerous other private facilities along the river edge that generally enable river access for the adjoining private landowner. While the influence of these facilities on the use patterns of the public facilities was not analysed, it was not considered significant to have a bearing on the assessment outcomes of this study.

Sites were inspected over a three day period between 19 and 21 January 2010. The assessment process involved the identification of particular features and characteristics of the sites and a determination of their value or quality as observed and recorded during the inspection. The assessment did not include the physical condition or life cycle of existing infrastructure which was considered to be beyond the scope of this study.

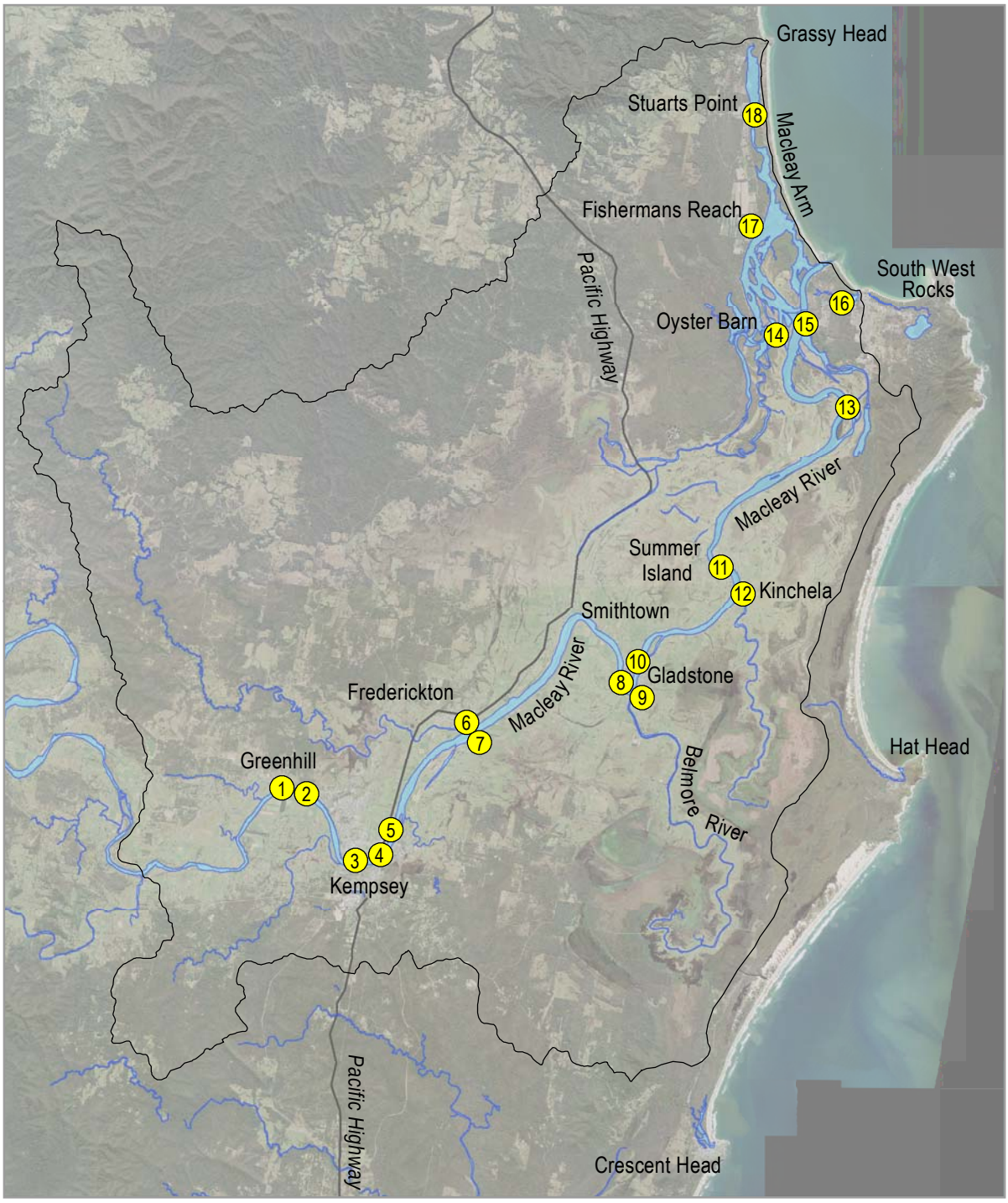
The criteria used in the assessment included a broad range of factors to reveal a comprehensive understanding of the use and value of the sites:

1. location and access
2. facilities and infrastructure
3. activities and operations
4. amenity
5. physical environment
6. opportunities & constraints

A summary of findings is provided on the individual site assessment sheets which follow.

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: May 2010*
*Source of base data: Kempsey Shire Council*




LEGEND

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2 Greenhill Quarry
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17 Fishermans Reach
18 Stuarts Point

North

0 5 km

# Investigation Sites

## 3.2 Site Assessment Summary Sheets

Site 1

### Greenhill Boat Ramp

| | | | |
|---|---|---|---|
| Location and Access | Former river punt approach on the northern side of the Macleay River near the small community of Greenhill. Vehicle via Old Greenhill Ferry Road from River Street, the main nearby arterial road. The road comprises a short, steep vehicle connection with a narrow sealed surface that continues down to the ramp. It also provides access to driveways of several adjoining residents. Limited car and trailer parking is available on the grassed verges of the approach road. | Facilities & Infrastructure | The access road and single lane concrete boat ramp are the dominant features of the site. The ramp is relatively steep although it is understood to be well liked and used by the boating fraternity. Recent flooding has removed base material from the bottom end of the ramp creating a hazard for boat handling.<br>The few site amenities include a picnic table, bin and a basic concrete structure for wood fired barbequing. |
| Activities and Operations | The ramp provides a modest river boat launching facility which is understood to be popular amongst the local boating fraternity. The predominant use is tinnies with some ski boats and It's capacity is constrained by the small scale of the site and lack of flat ground for complimentary site uses, particularly parking.<br>A terrace of mown grass adjoining the top of the ramp provides a small informal picnic area that overlooks the river. The relative remoteness of the site and difficult pedestrian access suggest that the site is largely only used by boat users. | Amenity | Highly attractive riverine setting created by enclosing landform, remnant native vegetation and elevated views to the scenic rural landscape across the river.<br>A small residential community overlooks the site providing passive surveillance and a sense of site security. In the wider context, the site offers a valuable visual and recreational resource to the local community where access to the river edge is otherwise very limited. |
| Physical Environment | Highly disturbed location.<br>South facing microclimate that affords protection from prevailing NE winds. Remnant riparian vegetation exists along adjoining sections of the river foreshore although weeds dominate the immediate surroundings and lower embankment of the site. | Opportunities & Constraints | *Attractive local setting that could be optimised with minimal effort to improve boat access and to provide low key foreshore setting* |

Site 2

## Greenhill Quarry

| | | | |
|---|---|---|---|
| Location and Access | A rough 4WD track extends into the site from River Street, the main nearby arterial road. The track is steeply graded in some sections but provides good access to lower areas adjacent to the foreshores. Public access is currently prevented by a locked gate at the River Street entrance.<br>There is no existing ramp access | Facilities & Infrastructure | There are no existing facilities on the site. |
| Activities and Operations | The site is currently restricted from public use and does not provide any recreational or boating access function. | Amenity | The quarry has created a highly enclosed, south facing site that is protected from prevailing NE winds, creating a pleasant summer microclimate. The southerly orientation will be detrimental in winter when the site is overshadowed and exposed to cold southerly winds.<br>Attractive views extend along the river in either direction and toward the rural landscape on the opposite side. The most rewarding views are available from the elevated position at the top of the quarry escarpment adjacent to River Street. |
| Physical Environment | Quarrying operations have significantly modified the profile of the site which is now characterized by a series of rock shelves, cuttings and a prominent vertical escarpment along the northern boundary.<br>While the site has been highly disturbed and degraded, evidence of the former quarrying activity is now disguised by native vegetation regrowth, weedy shrubs, vines and grasses which extend across embankments and the quarry floor. Most of the riparian vegetation has been removed although substantial remnant trees remain along the foreshores beyond the site. | Opportunities & Constraints | Significant area with highly attractive attributes presents significant opportunity for development as a major recreation area.<br>Location is remote would require considerable expense to implement and maintain.<br>The site occupies a high energy flood area. |

Site 3

## Kempsey Railway Bridge






| | | | |
|---|---|---|---|
| Location and Access | A 200 metre long poorly formed gravel track provides vehicle access to the ramp from Eden Street, Kempsey.<br>A major pedestrian corridor follows this track from the West Kempsey CBD and continues across the railway bridge to South Kempsey.<br>Vehicle access in the area is facilitated by flat terrain and the relatively generous area for car movement.<br>A concrete ramp provides boat access into the river. | Facilities & Infrastructure | A concrete ramp provides two access lanes. There are no other facilities. |
| Activities and Operations | The site is used only for boat launching.<br>Extensive space for car movement and parking allows considerable carrying capacity. | Amenity | Views are limited to the immediate environment due to the low lying, flat terrain.<br>The lack of protective vegetation creates a highly exposed, harsh setting.<br>The old railway bridge is a dominant element immediately adjacent to the site. The bridge offers considerable visual interest to the setting which otherwise lacks the scenic amenity of other riverside locations.<br>South facing orientation provides protection to boat users from prevailing NE winds in summer. |
| Physical Environment | The site forms part of the broader, highly disturbed low lying river flats that characterise this section of the river foreshore. The area is largely void of substantial tree cover. Weed cover forms dense thickets along sections of the foreshore. | Opportunities & Constraints | Remoteness from residential and public roads creates a high level of security concern, particularly for parked vehicles left unattended by boat users.<br>Large flat foreshore area provides considerable scope for more parking and foreshore recreation.<br>The site is flood prone. |

Site 4

## Riverside Park Kempsey

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| Location and Access | Good vehicular access into and through the park from Eden Street.<br>Fully formed car / trailer parking areas that appear to provide adequate capacity.<br>Site is within easy walking distance to the Kempsey CBD.<br>Footpaths provide continuous pedestrian / cycle access along foreshore to extremity of park area.<br>The boat launching and parkland areas have been purpose-designed on a gently sloping section of river embankment. | Facilities & Infrastructure | 2 purpose built boat concrete ramps provide 3 access lanes at the termination of a sealed access road.<br>A stepped timber jetty provides access along the edge of the eastern ramp.<br>No mooring facilities, wash down areas or pump out facilities are provided.<br>The boat launching area forms part of an integrated public park that includes car / trailer parking, toilets, playground, barbeques, picnic tables, shelters, path networks and a variety of open spaces. |
| Activities and Operations | The operational ramp provides a popular launching facility for a range of local users including recreational anglers and the local dragon boat club.<br>The lack of use of the second boat ramp suggests that the site is operating at below capacity. | Amenity | The foreshore parkland provides Kempsey with its pre-eminent public open space and most significant access point to the river foreshores. It is well designed and maintained with considerable vegetation providing shade and shelter to park users.<br>The park appears to be popular to the local community and is likely to attract travellers passing through Kempsey from the Pacific Highway due to its easy access and high visibility from the Macleay River bridge. |
| Physical Environment | Much of the natural environment has been modified with little if any remnant vegetation remaining.<br>Existing vegetation is approximately 10 years old and includes a mix of locally indigenous trees and riparian plants that have colonized undisturbed sections of the foreshore. | Opportunities & Constraints | River bed is shallow due to silt deposition, particularly following 2009 floods.<br>Silting has significantly impacted on the western ramp which is no longer in use.<br>The ramp is exposed to prevailing NE winds often making launching and returning difficult on summer afternoons.<br>There are security concerns during evenings when use levels within the park are lowest.<br>The site is flood prone.<br>Considerable opportunity to upgrade site through improved spatial planning and targeted provision of new infrastructure to optimise existing desirable site values. |

## Site 5

# Forth Street Kempsey





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|---|---|---|---|
| Location and Access | No formal river access is presently provided.<br>Excellent vehicular access is provided in close proximity to the river edge by the wide carriageway and turning circle of Forth Street.<br>A gentle gradient exists along the water's edge. | Facilities & Infrastructure | There are no existing facilities although a public footpath provides good pedestrian / cycle access beneath the Macleay River bridge to the Riverside Park where a range of public amenities are available. |
| Activities and Operations | Informal passive open space with an expansive grass cover that is routinely slashed.<br>Little evidence or encouragement of recreational use.<br>Highly underutilised site with considerable scope for boat launching and possible riverside parkland development to optimise existing site opportunities and to complement foreshore parkland further south. | Amenity | An attractive riverside experience created by the broad open grassed foreshores and protection from westerly winds and summer heat.<br>Excellent distant northerly views along the river corridor and toward the Macleay River bridge to the south. |
| Physical Environment | Relatively flat foreshore terrain with easy water access.<br>Subject to prevailing NE winds during summer.<br>Excellent stands of native vegetation follow the upper embankment of the foreshore.<br>Riparian grasses have established along the high water mark. | Opportunities & Constraints | Flood inundation.<br>Cost of installing new infrastructure.<br>Remoteness of site may attract antisocial behaviour although passive surveillance is provided from nearby vantage points that overlook the area.<br>May present launching difficulties due to exposure to prevailing NE winds in summer.<br>Deep water for optimal boat launching.<br>Large flat foreshores provide considerable scope for recreation development in close proximity to town centre and as an extension to Riverside Park.<br>Boat handling and movement may compromise existing use of cul de sac which provides turning area for large trucks servicing nearby Woolworths loading dock. |

## Site 6

# Frederickton North


| | | | |
|---|---|---|---|
| Location and Access | Small discrete site sandwiched between the Macleay River and the Pacific Highway within the built environment of Frederickton.<br><br>Highway access is difficult due to the corner location of the connection, and lack of turning bays and carriageway width on the highway.<br><br>Small land area adjacent to river is a significant limiting factor for optimal parking and car / trailer movement.<br><br>Ramp access into river provided by former river punt is steep but well utilised.<br><br>Small concrete apron adjacent to high water mark. Gravel approach is steep and rutted presenting likely difficulties for car trailer movement. | Facilities & Infrastructure | Single lane boat ramp created on a former river punt approach.<br><br>Minor improvements to site include bins, picnic table, shelter and a street light.<br><br>Functional gravel car park and access road offers basic level of service though inefficient use of site.<br><br>It is understood that the existing ramp may be removed if a new levee is built as part of the Pacific Highway bypass. Location options for a possible new ramp are currently being considered by Kempsey Shire Council in negotiation with the RTA. |
| Activities and Operations | Popular launching site by anglers, particularly local recreational fishing clubs such as Kempsey Bass.<br><br>Recreational activities limited by lack of appropriate facilities and visual amenity. | Amenity | Site has limited visual appeal due to lack of vegetation, design embellishments and site maintenance. It is exposed to prevailing climatic conditions; particularly NE winds, and lacks a sense of privacy from the surrounding environment.<br><br>Visitor experience is further detracted by close proximity and noise of highway.<br><br>Elevated position particularly from picnic area offers attractive views across river.<br><br>The site has considerable heritage value as an integral part of a former riverside industrial precinct which incorporates the adjoining old cheese factory. |
| Physical Environment | Highly modified and disturbed foreshore environment due to former intensive use of site for industrial purposes and river access.<br><br>No remnant native vegetation or habitat is evident. Extensive grass cover is routinely cut on flat areas but grows uncontrolled over embankments and coexists with other weed such as mulberry. | Opportunities & Constraints | Offers considerable scope for enhancement to provide a complementary riverside park for the Frederickton community and a higher level of amenity for anglers.<br><br>Improved pedestrian connection would facilitate greater use and integration with surrounding community.<br><br>Expansion limited by lack of space and hazardous access off Pacific Highway. |

Site 7

## Frederickton South





| | | | |
|---|---|---|---|
| Location and Access | Remote former river punt approach on the eastern river bank opposite the existing highly utilised Frederickton ramp.<br><br>The site is located at the termination of Frederickton Ferry Road which extends approximately 900 metres along a straight alignment east from South West Rocks Road.<br><br>The road comprises a poorly constructed gravel track that provides driveway access to the residence of an adjoining property. Beyond the residence, the western end of the access route to the river diminishes further and consists of a grassed farm access route.<br><br>The ramp is steep, gravelled and difficult to negotiate due to limited space. Informal parking on grass is possible at the top of the embankment. | Facilities & Infrastructure | The ramp is a remnant of the former river punt and offers no other improvements or function as a public facility. |
| Activities and Operations | Given its remoteness, lack of legible access and signage, use of the ramp is restricted to people with prior knowledge of its existence. It is understood to be a desirable option for river access by local anglers. | Amenity | This is a moderately attractive site that gains its visual character from a sense of remoteness and the surrounding rural environment. There is little site amenity at the ramp due to a lack of surrounding vegetation and flat terrain. |
| Physical Environment | The area is highly disturbed with no native vegetation or habitat evident. The site is dominated by an uncontrolled weed cover that extends from adjoining grazing paddocks down to the river. Several mature weed trees line the river embankment to the north. | Opportunities & Constraints | The site offers considerable potential to offer a greater role for river access. It is limited by lack of space and the considerable relative cost to upgrade site conditions and road access. |

## Site 8

# Riverside Park Smithtown





| | | | |
|---|---|---|---|
| Location and Access | Part of Riverside Park adjacent to the Nestle factory on a peninsula at a major bend in the river. The site is easily accessed via Belmore Street to the east and through a carpark off Park Street to the west.<br>Extensive car parking and pedestrian access enable excellent site integration with the surrounding community.<br>There is no existing infrastructure for public access to the river.<br>The site is generally flat or slightly undulating. The river edge has a gentle grade at the eastern end which becomes steep around the bend to the west. | Facilities & Infrastructure | Public facilities include plentiful car parking, a well established and maintained grassed open space, playground, toilets, picnic tables and shelters, barbeques and street lighting. |
| Activities and Operations | Variety of open spaces and public amenities and facilities provides considerable scope for active and passive recreational uses.<br>There are no water based activities associated with the river due to a lack of access.<br>A paddock of grazing horses separates the river from the southern edge of the park. | Amenity | Highly attractive public park setting with mature shade trees set amongst well maintained grassed open space. The park is a well used and valued resource for the local community.<br>Visual connection with the river is limited to particular vantage points on adjoining streets.<br>The riverside paddock and horses generate a tranquil rural character that enhances the scenic quality of the setting. |
| Physical Environment | It is a highly modified site with little remnant native vegetation either within the park or along the river foreshores. Large camphor laurels and expansive mown grass dominate the site creating strong visual identity and scenic quality.<br>New planting of native vegetation is emerging along the western river embankment.<br>Steep embankment to river. Embankment forms part of the flood levee<br>Weeds occupy significant foreshore areas where there is little or no maintenance. | Opportunities & Constraints | This site offers considerable scope as an additional river access point due to the existing complementing public facilities and uses.<br>It is also protected from prevailing NE winds offering a desirable alternative access point when other sites are being impacted.<br>There is good potential for revegetation improvement. |

Site 9

## Wharf Reserve Gladstone


| | | | |
|---|---|---|---|
| Location and Access | These facilities are located as a riverside embellishment to Wharf Reserve in the centre of Gladstone.<br>The facilities include steps down the steep embankment and a small timber platform to facilitate temporary mooring of small vessels and the setting down and picking up of passengers. | Facilities & Infrastructure | The small timber platform and steps form a complementary component of the facilities provided in the adjoining park which include a playground, toilets, picnic shelters, barbeques and lighting. |
| Activities and Operations | The platform provides limited although highly valued riverside access for a small number of pedestrians and temporary mooring for one or two small vessels. This facility complements the provision of amenities within the adjoining park to provide a broad range of land based and limited riverside recreation activities such as fishing. | Amenity | Highly attractive riverine setting created by the existing established public park and the historic setting of the village. The park is a highly valued local asset and an attractive destination for visitors either by boat or vehicle.<br>The elevated park setting provides attractive prospect for distant views both up and down stream of the river. |
| Physical Environment | The site is highly disturbed and occupies a steep section of river bank which plateaus at the top into the park. The embankment comprises mown grass adjacent to the park and unmaintained weed growth beyond. Little native vegetation exists, although some aquatic vegetation is evident.<br>The park contains a formal mix of established native and exotic trees in a highly maintained grassed setting. | Opportunities and Constraints | Potential to increase mooring facilities to optimise value of site as an attractive destination for day visitors arriving by boat from up or downstream. |

Site 10

## Smithtown Boat Ramp

| | | | |
|---|---|---|---|
| Location and Access | The site forms part of a small riverside park near Smithtown Bridge at the eastern end of Main Street, Smithtown.<br>It is easily accessible to cars and pedestrians.<br>The ramp utilises a former river punt approach and is relatively steep.<br>A nearby wharf with boat moorings and a stepped platform provide convenient passenger boat access and landings for riverside fishing. | Facilities & Infrastructure | The single lane concrete ramp has a sealed approach.<br>A nearby historic timber wharf was refurbished in 1995 and provides additional water edge access.<br>The land area adjacent to the ramp and wharf is narrow and offers limited access.<br>Land-based facilities are provided within the nearby park and include picnic tables, shelters, toilets, barbeques, bins, street lighting and an expansive parkland setting.<br>The site and nearby streets provide a high level of car parking capacity |
| Activities and Operations | The ramp, wharf and adjoining park provide an optimal setting for water access and a range of riverside recreational activities. These facilities are within close reach to the residents of Smithtown and are therefore likely to be highly valued as an important local resource. | Amenity | This site presents a moderately attractive setting with a range of good facilities for boating access and associated land-based recreation uses. It also offers an attractive outlook across the river and nearby Smithtown bridge in particular.<br>The site lacks shade trees and other site vegetation that would otherwise significantly enhance its visual character.<br>Good passive surveillance is provided by the surrounding houses and hotel which overlook the site. |
| Physical Environment | The site has been highly disturbed and comprises little remnant vegetation. Native aquatic grasses are apparent along the waters edge while weed dominates the embankment. Several large indigenous trees remain along the embankment south of the site. | Opportunities and Constraints | Improvements including revegetation, better vehicle control and embellishment of the riverside setting as part of the adjoining parkland would significantly optimise the value of the site. |

Site 11

## Summer Island

| | | | |
|---|---|---|---|
| Location and Access | This former river punt approach is located off Croads Esplanade that runs parallel with the river edge creating a narrow land strip between river and road. The ramp occupies a small awkward site that has been built on a cutting through the original river embankment. Lack of space and adequate sight lines creates difficult and dangerous conditions for reversing vehicles off Croads Esplanade. Lack of road shoulders also limits parking opportunity. | Facilities & Infrastructure | Apart from the ramp there are no public facilities on the site.<br>The ramp comprises a poorly maintained loose gravel base.<br>A private mooring and jetty is located nearby downstream of the site. |
| Activities and Operations | The ramp provides a modest river boat launching facility which is understood to provide convenient river access to the local boating fraternity. Its capacity and value is significantly constrained by the limited available land area and awkward connection onto Croads Esplanade. The relative remoteness of the site and lack of pedestrian access suggest that the site is entirely used to launch and retrieve small boats. | Amenity | Scenic river vistas are available to passing traffic along Croads Esplanade across private river side land on either side of the ramp. The site offers little visual or recreational appeal due to the lack of foreshore vegetation, space or facilities.<br>The site is highly exposed to prevailing conditions; in particular, strong NE winds in summer. |
| Physical Environment | The narrow site landform of the site has been entirely modified to facilitate the provision of the ramp. Native wetland species such as phalaris grow along the river edge. Elsewhere, however, the foreshore is dominated by uncontrolled weed growth that typifies the foreshore environment in this middle section of the study area. | Opportunities and Constraints | Limited available space and greater potential elsewhere limits the potential and value of this site for further development. |

Site 12

## Kinchela

| | | | |
|---|---|---|---|
| Location and Access | A small, poorly formed ramp providing access into Kinchela Creek near its confluence with Macleay River in the small village of Kinchela. This highly concealed ramp is accessed from the eastern section of Riverside Drive along a barely formed track that passes beneath the South West Rocks Road bridge. The site is easily accessed by nearby footpaths from either side of the village. | Facilities & Infrastructure | The gravel track and boat ramp provide the only infrastructure on the site. |
| Activities and Operations | The site only offers limited small boat access into the river. Given the difficulty of locating the site and extent of overgrowth across the access track, it may be assumed that the ramp is only used by a small number of people with strong site familiarity. | Amenity | The secluded location of the site and its unkempt appearance generate a forgotten and highly uninviting public facility. It does, however, offer an enclosed sheltered southerly position along a tranquil section of water in contrast with other more exposed Macleay River locations. |
| Physical Environment | The site occupies gently sloping land along the northern foreshores of Kinchela Creek. It has been highly modified largely due to the construction of nearby South West Rock Road bridge.<br>Native aquatic grasses form a dense cover along the edge of the creek. The remainder of the site, however, is dominated by a range of woody and herbaceous weeds that crowd the access road and extend as a continuous band along the river and creek foreshores. | Opportunities and Constraints | This highly underutilised site has considerable scope to provide a range of site facilities within an attractive, protected setting for boat access and other land-based recreational uses. |

Site 13

## Jerseyville Boat Ramp


| | | | |
|---|---|---|---|
| Location and Access | This well established, purpose built facility is located on the western foreshores of the Macleay River opposite the small settlement of Jerseyville. It offers two boat ramps including a steeply sloping former river punt approach and a purpose built facility that has been constructed to a gentler, compliant gradient. The site has good vehicular access onto Plummers Lane and provides for easy vehicular movement and car / trailer parking. Pedestrian access from nearby Jerseyville is provided across Plummers Lane bridge. | Facilities & Infrastructure | The site includes a wide, fully sealed driveway that leads to turning areas adjacent to the boat ramps and extensive car / trailer parking areas.<br>The two boat ramps are concrete sealed.<br>There is expansive open space around the site incorporating mature shade trees.<br>Grass areas are generally barricaded from vehicles access.<br>Other site facilities include fish cleaning facilities, shelters, picnic tables, bins, barbeque and toilets. There is no street lighting.<br>Revegetation on adjoining foreshore land incorporates a walking track that provides further visual and recreational interest and demonstrates a positive environmental initiative by the local community. |
| Activities and Operations | The ramps are understood to be popular amongst local fishing clubs and recreational anglers. The picnic area and walking tracks cater to a relatively large number of users seeking low key land-based recreational activity.<br>The site also provides a convenient place for passing travellers to briefly stop to gain a sense of orientation of the area and to enjoy the easy visual connection with the river. | Amenity | This foreshore setting offers attractive river views particularly across to Jerseyville where the moored fishing boats provide considerable visual interest.<br>The site has some scenic attributes generated by the trees and expanse of green space. However, there is a lack of substantial vegetation throughout the site which is dominated by roadway for car movement. The adjoining revegetation area is a significant natural asset that could be further optimised as an integral part of the riverside park.<br>Rock reinforcement along the river edge further detracts from the site's visual quality and creates a barrier for water edge access. |

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| Physical and Natural Environment | The site forms part of the open, flat foreshore landscape that characterises many sections of the western riverfront within the middle and lower sections of the study area.<br><br>Native riparian vegetation is noticeably absent along the riverfront, although stands of mangrove and casuarina extend immediately downstream of the site.<br><br>The scattered trees throughout the picnic area offer some environmental benefit. More important is the adjoining area of revegetation which provides a rich diversity of locally indigenous species. This planting will be of increasing value as it matures.<br><br>The lack of protective vegetation and easterly orientation creates a high level of exposure to prevailing weather conditions, particularly NE winds in summer. | Opportunities and Constraints | Highly developed and utilised site that has scope for improvement as a more attractive boating and riverside recreation area without considerable expense. |

Site 14

## Oyster Barn Boat Ramp

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| Location and Access | This informal boat access point is located adjacent to an oyster processing shed on a remote section of Clybucca Creek, a small tributary that forms part of the estuary delta near the river mouth.<br>Vehicular access is gained off Plummers Lane via Suez Road or Rainbow Reach Road, two minor gravel corridors that service local farms and oyster leases in the area. Rainbow Reach Road terminates at the site.<br>River access has been created by gravelling a long cleared section of the foreshore. | Facilities & Infrastructure | There are no facilities provided on this site as it is not a recognised public ramp.<br>The ramped river edge has a gravel surface and is gently graded into the water.<br>The ramp and adjoining access road offer reasonable space for small craft launching, car / trailer movement and parking. |
| Activities and Operations | The ramp is largely used by local oyster growers within the estuary. It is understood that the ramp also provides occasional river access for a small number of local recreational anglers who are familiar with the site. | Amenity | This is a harsh unattractive setting that offers little visual or recreational appeal. It is characterised by a lack of vegetation, uncontrolled vehicle access, boat remnants and discarded waste from oyster handling operations. The nearby oyster handling shed and overhead power lines are visually dominant and further detract from the setting. |
| Physical Environment | The site occupies low lying river flats that are poorly drained and comprise salt marshes and mangroves. The immediate setting of the ramp has been highly modified for oyster handling operations which have had a detrimental impact on the natural environment.<br>The protected waterway is not as subject to dynamic river currents or exposure to prevailing NE winds. | Opportunities and Constraints | The low lying terrain is susceptible to high tide inundation which limits its potential for possible future public use to limited and specific timeframes.<br>Remoteness and lack of passive surveillance are detrimental to the site's sense of security.<br>Increased public use of the site may also conflict with oyster handling operations.<br>Provides easy access to waterway with possible minimal infrastructure expense. |

Site 15

## Mattys Flat Boat Ramp





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| Location and Access | Located on the banks of the main river channel approximately 3 kilometres from the river mouth.<br><br>The site is easily accessed to vehicles and pedestrians from New Entrance Road, nearby residential areas and the centre of South West Rocks some 3.5 kilometres to the east<br><br>This is a highly popular location for boat launching and retrieval due to its proximity to the main river mouth and access to a range of downstream sections of the river. | Facilities & Infrastructure | Boat launching is provided by two concrete ramps: an original, relatively steep single lane facility, and another, purpose built ramp with two lanes separated by a floating pontoon.<br><br>The site has a large bitumen car / trailer park, turnaround and access road. These areas have street lighting.<br><br>There are fish cleaning and boat washing facilities, and a privately operated boat shed with goods and services for the boating and fishing fraternity.<br><br>A small adjoining riverside park includes toilets, playground and picnic shelters.<br><br>Boat mooring is available within a private compound adjacent to the boat shed. |
| Activities and Operations | The ramp provides boat access for recreational anglers, charter dive boats, personal water craft and ski boats.<br><br>Passengers are set down and picked up from the pontoon.<br><br>Water skiers set off from the nearby sandy foreshore.<br><br>A small commercial boat shed provides goods and services for the boating and fishing community.<br><br>A small riverside park provides an attractive setting for land-based recreation. | Amenity | This is a moderately attractive setting that offers open, expansive river views to the west. The car access and parking area dominate the site and detract from the site's scenic value. This is further affected by the clutter of site facilities and the poor provision for car and pedestrian access which is particularly evident during peak periods of use.<br><br>The nearby riverside park is an important counter to the carpark area offering a popular destination for day users and a complementary setting for river-based activities. |
| Physical Environment | The site occupies a relatively low lying riverside landscape that includes few natural elements within the intensively developed carpark / boatshed area where boating infrastructure dominates.<br><br>Considerable natural vegetation has been retained or planted within the adjoining parkland area. The park blends into natural mangrove vegetation further south which is protected under SEPP 14 legislation. | Opportunities and Constraints | User demands generate conflicts during peak periods resulting in a general loss of site amenity.<br><br>The scope to address the issues through expansion of existing facilities is constrained by the lack of available additional space. |

Site 16

## Back Creek Boat Ramp

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|---|---|---|---|
| Location and Access | This developed boat launching facility is conveniently located off Gordon Young Drive, South West Rocks.<br>The site is well serviced by generous, flat areas for car movement, parking and boat launching. | Facilities & Infrastructure | The bitumen access road and parking areas are dominant features of the site.<br>A 2-lane ramp has a ridged, concrete surface and a relatively gentle slope into the water.<br>The site has a range of good facilities for boat users including fish cleaning basins, a boat washing area, and basic picnic tables. Street lights are located near the ramp. |
| Activities and Operations | The ramp is an important and popular access point into Back Creek which has been the traditional route for small boats accessing the ocean.<br>The foreshore area forms part of a broader recreation reserve along Back Creek which is highly attractive and used for passive recreation particularly by visitors from the nearby caravan and camping area. | Amenity | This is a highly attractive riverine setting with mature remnant native vegetation and scenic views along the creek. The natural vegetation encloses and protects the site creating a sense of isolation. There are no surrounding residents which limits the level of site security, particularly after dark. |
| Physical Environment | The site contains much of its original natural vegetation including mangrove, casuarina, melaleuca and eucalyptus communities.<br>The foreshore area is generally flat and is only slightly elevated above the creek. The combination of desirable terrain, abundant vegetation and northerly aspect help to moderate climatic conditions and create an optimum setting for passive recreational use. | Opportunities and Constraints | Build up of silt within the creek channel and ocean bar has created a significant hazard for navigation and boat movement a dropping tide.<br>River access is constrained by rocky edges along either side of the ramp which create an awkward and often slippery area for setting down or picking up boat passengers.<br>The value of the site is limited by lack of public amenities such as toilets and picnic facilities. |

Site 17

## Fishermans Reach Boat Ramp





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| Location and Access | This ramp is located at the southern end of Fishermans Reach Road which extends along the western edge of the Macleay River Arm from Stuarts Point in the north. The road provides the only vehicular access into the area for local residents.<br>The boat ramp is aligned at an angle to the river providing a gentle gradient to the water.<br>Vehicle access, parking and turning area is generous but unrestricted, suggesting that the site would be inefficiently used during peak periods. | Facilities & Infrastructure | The site comprises basic infrastructure for boat access including bitumen driveway, unformed car parking area, turning head, unformed boat ramp approach and small concrete platform adjacent to the river edge.<br>There are no other site amenities to encourage compatible riverside recreation opportunities. |
| Activities and Operations | The ramp provides a modest river boat launching facility which is understood to be very popular amongst the boat users.<br>The lack of site development and embellishment diminishes the value of the location as an attractive local destination for other recreational purposes. Fishing from jetties and along the foreshore has been observed in nearby riverside areas. | Amenity | This is a highly attractive riverine setting created by the natural attributes of vegetation, sandy foreshore and a scenic river outlook.<br>The site is exposed to prevailing NE winds. |
| Physical Environment | The site is surrounded by remnant native trees including large blackbutts which characterise the area. Native vegetation including grass and shrub species forms a well established fringe along the river side, helping to maintain stability of the foreshore embankment. | Opportunities and Constraints | The site offers ample space and good level land to enable a range of development opportunities.<br>Protection of existing foreshore vegetation is paramount. |

Site 18

## Stuarts Point Boat Ramp






| | | | |
|---|---|---|---|
| Location and Access | This boat ramp provides a key focal point for the Stuart Point community and a significant number of its visitors.<br><br>The ramp is located at the eastern end of the main road that passes through the village and forms the primary entry into the river side reserve and adjoining caravan park.<br><br>The boat ramp comprises a continuous bitumen sealed approach and a concrete based ramp adjacent to the waters edge.<br><br>The ramp and approach are in fair condition. | Facilities & Infrastructure | The access road, turning area, single lane concrete boat ramp and grassed and sealed car / trailer parking areas are the dominant features of the site. The site has street lighting.<br><br>A well established riverside park adjoins the ramp area which includes grassed open spaces, shade trees, a playground, toilets, barbeques and picnic facilities. A tennis court is also located nearby.<br><br>A footbridge is located further south providing pedestrian access over the river to the ocean beach. The bridge is a highly visible element and an iconic feature of the village. |
| Activities and Operations | The ramp provides access to a broad range of small scale boating uses particularly those which are family oriented. These include fishing, skiing, sailing and canoeing. The area is also popular for swimming, on-shore fishing and other low key, simple recreation activities undertaken during family holidays.<br><br>Site uses are complemented by the adjoining picnic and playground facilities which are a highly popular destination within the village.<br><br>A speed limit of 4 knots exists in the water area adjacent to the boat ramp. | Amenity | The ramp site and adjoining recreation areas combine to create an attractive riverside setting that offer the charm of a traditional, relaxed coastal holiday experience.<br><br>The ramp area incorporates a modest grassed setting that is dominated by the access road, ramp and parked cars and trailers.<br>It has attractive easterly views across the river. Remnant trees provide a moderate level of shade. |
| Physical Environment | While the area has been highly modified for vehicle access and recreational use, remnant vegetation remains along the foreshore and throughout the site. These are complemented by other native and exotic trees that have been established within the reserve. The foreshore area is generally flat and is only slightly higher than the water level providing optimal conditions for foreshore access and recreation.<br><br>Lack of sufficient protective vegetation and possible wave action from passing boats may be contributing to erosion and scouring along downstream sections of the river edge. | Opportunities and Constraints | The site is constrained by lack of space to adequately cater to peak requirements.<br><br>Highly popular setting would benefit from minor improvements. |

**Table 3.1 Summary of Infrastructure Assessment**

| | Greenhill Boat Ramp | Greenhill Quarry | Railway Bridge | Riverside Park | Forth Street | Frederickton North | Frederickton South | Riverside Park, Smithtown | Wharf Reserve, Gladstone | Smithtown Boat Ramp | Summer Island | Kinchela | Jerseyville Boat Ramp | Oyster Barn | Mattys Flat | Back Creek | Fishermans Reach | Stuarts Point |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BOAT LAUNCH SITE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Number of ramps / lanes | 1 | - | 2 | 3 | - | 1 | 1 | - | - | 1 | 1 | 1 | 2 | - | 3 | 2 | 1 | 1 |
| Construction type | C | - | C | C | - | C | G | - | - | C | G | C | C | G | C | C | G | C |
| Slope | S | - | G | G | - | S | S | - | - | S | S | G | G | G | G | S | G | G |
| Marine structures | - | - | - | J | - | - | - | - | W | W | - | - | - | - | P | - | - | - |
| Access roads | S | U | U | S | S | U | U | S | - | S | U | U | S | U | S | S | U | S |
| LAND SIDE AMENITIES | | | | | | | | | | | | | | | | | | |
| Car / trailer parking | Y | N | Y | Y | N | Y | N | Y | N | Y | N | N | Y | Y | Y | Y | Y | Y |
| Toilets | N | N | N | Y | N | N | N | Y | Y | Y | N | N | Y | N | Y | N | N | Y |
| Lighting | N | N | N | Y | Y | Y | N | Y | Y | Y | N | N | N | N | Y | Y | N | Y |
| Wash down area | N | N | N | Y | N | N | N | N | N | N | N | N | N | N | Y | Y | N | Y |
| Fish cleaning facilities | N | N | N | Y | N | N | N | N | N | N | N | N | Y | N | Y | Y | N | Y |
| Managed open space | Y | N | N | Y | Y | Y | N | Y | Y | Y | N | N | Y | N | Y | Y | N | Y |
| Picnic seats and shelters | Y | N | N | Y | N | Y | N | Y | Y | Y | N | N | Y | N | Y | Y | N | Y |
| Barbeques | Y | N | N | Y | N | N | N | Y | Y | Y | N | N | Y | N | Y | N | N | Y |
| Playground | N | N | N | Y | N | N | N | Y | Y | Y | N | N | Y | N | Y | N | N | Y |
| USAGE PATTERN | | | | | | | | | | | | | | | | | | |
| Boat launching demand level | L | - | L | H | - | H | L | - | - | H | L | L | M | L | H | H | H | H |
| Land based recreation | L | - | L | H | - | L | L | H | H | M | - | L | M | L | H | M | L | H |
| Possible user conflicts | L | - | L | H | - | M | L | - | - | L | L | L | M | M | H | H | H | H |
| Opportunity for expansion | L | H | H | L | H | L | M | H | L | L | L | M | M | M | L | M | M | L |
| SITE CHARACTERISTICS | | | | | | | | | | | | | | | | | | |
| Scenic quality | H | H | M | H | M | L | M | H | H | M | L | M | L | L | M | H | H | M |
| Natural values | M | H | L | M | M | L | L | L | L | L | L | M | M | L | M | H | H | M |
| Exposure to prevailing winds | L | L | L | M | M | M | M | L | M | M | M | L | M | L | M | L | M | M |
| Site condition / maintenance | L | L | L | H | M | L | L | M | H | M | L | L | M | L | M | M | L | M |

Construction type
C Concrete
G Gravel

Slope
S Steep
G Gradual

Marine structures
P Pontoon
J Jetty
W Wharf

Access road
S Sealed
U Unsealed

Land side amenities
Y Yes
N No

Usage patterns / site characteristics
M High
M Medium
L Low

# 4

# Community Consultation

## 4.1 Overview

This section aims to identify and analyse the key issues, interests and values that define the quality of access and use along the river. An important part in this process is the contribution of the local community in providing an accurate understanding of the scope of existing usage patterns. Community participation was also vital in revealing locally relevant issues and in gaining opinions on the ability of the existing marine infrastructure to meet current and future needs.

## 4.2 Methodology

The study area contains a broad range of communities that are spread along the entire length of the lower Macleay River. These communities share a relationship with the river which provides them with economic well-being and an important visual and recreational resource. There is also considerable variation in the size and mix of the communities and this is reflected in the particular way that they use and identify with the river.

In order to capture the diverse spread of community input and interest within the study area and to achieve this within a manageable timeframe, a two stage consultation strategy was undertaken. The first involved a community survey that aimed to ensure opportunity for input from every community member. The second comprised targeted communication with key stakeholders and interest groups including representatives from public agencies, private or commercial interests, and the general community. The particular methods and outcomes of each process are described separately below.

### 4.2.1 Community Survey

A boating survey was conducted over a two month period from 21 December 2009 to 5 February 2010 as part of a wider and more general survey and consultation process for the Estuary Management Plan. The survey period coincided with school summer holidays when visitor numbers and recreational and commercial tourism activity in the region were at a peak. This provided an opportunity to capture input from the widest possible catchment of users of the facilities and access points.

The survey method involved the following steps:

- preparation of a detailed questionnaire containing 15 multiple choice and written response questions **(see copy at Appendix A1);**
- placement of survey forms and lodgement boxes at the following venues within the study area:
  - Stuarts Point Supermarket & Liquor Mart;
  - Stuarts Point Holiday Park;
  - SWR Boatshed, Mattys Flat;
  - NSW Maritime Office, South West Rocks;
  - Rocks Marine Bait & Tackle, South West Rocks;
  - Smithtown Post Office and General Store;
  - Gladstone General Store;
  - CJ's Tackle and Sport, Kempsey; and
  - Kempsey Shire Council office, Kempsey.
- placement of survey notices in local print media and the Kempsey Shire Council website.

### 4.2.2 Survey Results

A total of 131 completed forms for the boating survey were received at the conclusion of the survey period **(see full results at Appendix B1)**.

Respondents identified themselves as residents from the following locations:

- 37%Macleay Arm area;
- 20%South West Rocks / Jerseyville;
- 20%Frederickton / Kempsey / Greenhill;
- 9% Kinchela / Gladstone / Smithtown;
- 6% Elsewhere within the Kempsey LGA;
- 3% Port Macquarie / Hastings LGA;
- 2% Nambucca LGA;
- 2% Elsewhere on the Mid North Coast;
- 1% Elsewhere in NSW; and
- 1% Interstate / overseas

98% of recipients used their vessel for private / recreational use as opposed to business / charter.

Recreational fishing is the primary boating activity (97 respondents) with recreational boating as the second main activity (64) and paddling third (36).

Open runabouts ('tinnys') were the most commonly used vessel type (38%) and canoes / kayaks second (23%).

Fishermans Reach received the highest score as the main boat launching site (43 responses), Jerseyville second (34) and Stuarts Point third (32).

The destination for the majority of boat users was within 5 km of the launch site (78 responses). Over 5 km from launch location was second (50) and out to sea was third (38).

Boating on a weekly basis was the most common frequency of river access (45%), and monthly second (34%).

The majority of respondents (60%) believed that the natural aspects of the Macleay River for recreational boating were similar to other estuaries. The Macleay was the preferred estuary in this regard by 29% of respondents while 11% listed the Macleay as the least favoured.

56% of respondents believed that the facilities and boating infrastructure on the Macleay River were similar to other estuaries. 32% of respondents prefer the Macleay over other estuaries and 12% listed the river as the least favoured.

60% of respondents agreed that navigational aids along the Macleay River are a good standard and assist with navigation.

Approximately 95% of all recipients placed values associated with natural environment and scenic quality, recreational opportunities, ability to pursue river in a fair and equitable manner and protection of the river activities as very important or important.

88% of respondents placed very important or important on values associated with adequacy of boating infrastructure and amenity – proximity to services, ease of access, facilities to support boating activity.

The issue identified as 'difficult navigation locations due to limited depth' was only highlighted by 59 respondents. However, these respondents indicated this to be a very significant issue.

Respondents also provided written comments on the surveys. These have been summarised and consolidated with comments from the stakeholders to form a list of key issues.

### 4.2.3 Stakeholder Consultation

Direct input was sought from various stakeholders and organisations with a particular interest in boating activity within the estuary. This involved an initial round of letters followed by on-site meetings at Kempsey, South West Rocks and Stuarts Point with representatives from the following organisations and recreational groups:

- NSW Maritime;
- Department of Environment, Climate Change & Water;
- Kempsey Bass;
- River Fishing and Trapping;
- Stuarts Point Community Organisation;
- Sea Urchin Fishing Charters;
- Sea Breeze Fishing Club;
- South West Rocks Dive Centre; and
- Water Skiers.

The key issues identified have been consolidated and incorporated into the list of key issues identified and described in the following section.

## 4.3 Key Issues

The most significant issues identified from comments made in the community survey and in consultation with stakeholders have been summarised and consolidated to form the basis for further analysis. The comments included a range of general concerns that affected the whole or key parts of the estuary while others were site specific. These have been grouped accordingly below:

### 4.3.1 General

*Ocean Access*

- ocean access via the main (river) bar is the main issue to many people interviewed. According to some, this has become worse over past 10 years with 8-12 boats going down every year. There is a washpool effect of three influencing factors: river waves, tide and NE winds;
- there is also serious concern that the Back Creek bar is now almost inaccessible due to siltation. Use of this bar is favoured for small vessels over the river bar as it is considered much safer. It is also more convenient than the river as it has its own boat ramp and associated facilities thereby taking the pressure off the limited facilities on the river;
- increasing navigational difficulties generally will deter tourists from visiting the area in favour of safer boat launching and ocean access locations elsewhere. This may have a serious impact on the local economy of South West Rocks as tourism associated with recreational boating accounts for up to 60% of the local trade. Prosperity of this community is inextricably linked to the waterways;
- commercial fishing on the river including fleet trawling and netting drew strong criticism from many community survey respondents and stakeholders. It has been identified by some as the main reason for the reduction in fish stocks in the estuary and should be banned. There is also concern that commercial fishing is not adequately policed/regulated; and
- there is a need for better strategic consideration to be given to future upgrading and development and management of facilities within the SWR area, particularly in the future planning and redevelopment of Mattys Flat boat ramp.

*Existing Marine Infrastructure*

- concern that there is a general lack of adequate, safe launching facilities within the estuary. More boat ramps with public wharves, jetties and pontoon access is a major requirement. It is difficult for a single person to launch and retrieve boats at most public boat ramps;
- improved amenities should be provided to enhance riverside locations as a destination for family day use and recreational boating. Facilities should be available for easy temporary boat mooring to

enable users to pull up, get food and drinks and use toilets. There is also a lack of good boat washing, and fish cleaning facilities and adequate lighting;

- concern for rubbish deposited at boat ramps, particularly during holiday periods. Need for additional bins, collection services and an education campaign to increase public awareness;
- weed growth along banks is a serious problem, particularly at several key launching sites. This will be an ongoing problem as there is a considerable source of weed seed in silt deposits from recent floods; and
- better ongoing maintenance of ramps is required to ensure their optimal use. Ramps should be routinely cleaned to prevent them becoming slippery. There is also a need to replace base material at the toe of many ramps which was removed during recent floods creating a hazardous drop for boat launching.

*Use and Activities*

- there is concern for conflict or incompatibility between uses and their proximity to nearby communities. It was suggested that this could be overcome if designated areas were created for motorised boats which could be restricted to wide, non-residential sections of the river. This will ensure a safer water environment for non-motorised boat users and swimmers.
- PWC's and skiing should be banned within 300 metres of boat ramps;
- designated sites should be provided for canoe launching;
- consider Rainbow Reach area for water skiing as it has good soft foreshores;
- new sites for boat public launching should be considered at the Oyster Barn, new Jerseyville Bridge east of village; Woolworths site in Kempsey, new Smithtown facility near the Nestle factory, former coal wharf and former pilot station site near the Macleay River mouth; and
- safety and navigation within river is generally well regarded. This was facilitated with the provision of good mapping by NSW Maritime.

*Environmental Impact*

- conservation and natural values of the estuary were highly regarded. There was particular interest in enhancing and returning foreshores to a natural state through revegetation; and
- concern that wave wash caused by motorised vessels has contributed to bank erosion within the estuary. This could be overcome if a speed limit was imposed on larger craft.

### 4.3.2 Greenhill / Kempsey / Frederickton

- there is support for small improvements to infrastructure at the Greenhill Boat Ramp. There is no need for additional barbeques or picnic facilities as they are unlikely to be supported by local residents. The end of the boat ramp drops off vertically and requires gravel filling;
- doubts were raised for the potential of the former Greenhill quarry site for redevelopment as a new boat launching and riverside park. The site is at considerable risk from antisocial behaviour due to its isolation and lack of surrounding passive surveillance. Concern includes objects being thrown from the top of the embankment, security of vehicles left unattended by boat users and vandalism of new infrastructure. It was felt strongly that money would be wasted on this site;
- boat users are reluctant to use the railway bridge (Kemp Street) boat ramp as vandalism and site security are a real problem;
- boating activity at the Riverside Park in Kempsey and the use of the old ramp in particular has been compromised by siltation and inadequate water depth. Siltation has also affected navigation between the road and rail bridges. There is also a considerable weed problem along the foreshores impacting boat access;
- river access should be improved by dredging as a priority. A new wharf and an integrated jetty and boardwalk structure should also be considered. There was also a suggestion that boardwalks with mooring facilities could also be considered between the park and the foreshores adjacent to Woolworths further downstream;
- opportunities should be explored to increase boating activity in the park by improved and expanding facilities. The location is becoming increasingly popular for dragon boat paddling and it could attract

other compatible users such as rowers (with possible establishment of a rowers club) and other non-motorised boats supported by hiring facilities;

- increased park activity should be encouraged to optimise the site attributes and to enhance site security. This could be achieved by improving access to the river from CBD for cars and vans, promoting the site for community events and possibly incorporating a marina with riverside cafes.
- the 'Woolworths' site downstream of the Pacific Highway bridge was identified as a great opportunity for a new boat launching facility due to optimal water depth;
- the existing ramp at Frederickton is very slippery and lacks traction. Available space for parking and vehicle turning is a major limiting factor and key issue of the site; and
- the southern Frederickton ramp lacks maintenance but if upgraded would be very desirable to serve existing and boat launching future capacity. The site has navigational problems with weed at low tide.

#### 4.3.3 Smithtown / Gladstone / Kinchela / Summer Island

- there is a need for a boat ramp at Gladstone;
- speed restriction should be placed between Smithtown Bridge and Belmore River to prevent erosion of residential properties;
- possible development of the foreshores adjacent to the public park near the Nestle factory was recommended as the site has lots of potential. It would be good for water skiers as it is flat, low level and protected from prevailing NE winds. It would be relatively easy to implement compared to other possible new sites;
- there is a need to improve the ramp at Kinchela which is currently little used but is a good location for water access; and
- summer Island has very difficult access and should be considered for possible removal.

#### 4.3.4 Jerseyville / Oyster Barn / Rainbow Reach

- the site provides a good alternative to Mattys Flat. Its distance to the ocean and associated additional fuel requirement was not considered an issue by some of the stakeholders, but this was raised as a limiting factor by others;
- there was considerable disappointment expressed that infrastructure work at the site was not completed in accordance with an original plan which was prepared in consultation with and approved by 7 local clubs. The original vision included better parking areas, a wharf and lighting;
- there is concern that there is no pull up area or mooring area for boats adjacent to the ramp. Existing poles in this vicinity are a problem as they scratch boat hulls;
- existing ramp surface is slippery, raising concern for public safety;
- a dual ramp would be optimal. This should be complimented with a floating pontoon (in preference to a stepped jetty) and mooring facilities;
- an alternative boat ramp for possible for canoe / kayak launching could be considered near the new road bridge on the eastern side of Jerseyville to optimise the easy public access and the safe conditions afforded by a protected section of water;
- the existing Oyster Barn site was commended for possible upgrade to provide better boat launching for estuary fishers. The site may require a pontoon; and
- use of the southern side of Rainbow Reach should be explored for greater public use as the area provides excellent soft foreshores for water skiers. The land is privately owned.

#### 4.3.5 Mattys Flat

- there were a range of issues identified with the use of Mattys Flat. Many of these were common amongst stakeholders or survey respondents while others reflected the concerns and requirements of particular interests. The most significant concern related to the lack of carrying capacity to meet peak demand;
- there was a strong concern that the improvements should be made to existing facilities to increase capacity including the resurfacing of the old ramp and the provision of a tie-up structure such as a floating pontoon and jetty that possibly extended down the middle of the ramp to create a dual use facility. The site could also incorporate a new pump out facility and additional fish cleaning facilities;

- pressure on the site could be off-set with an upgrade of the former coal wharf further downstream to take the load off Mattys Flat during peak use. This site has considerable potential to facilitate loading and unloading passengers and to provide other amenities. It also has considerable available space for car parking and pedestrian movement; and
- the range and concentration of activities at the site created a number of conflicts amongst users. These generated a number of suggested modifications to site management including:
  - designate a water skiing area near the boat shed;
  - no boat or yacht mooring should be permitted near the sand beach to overcome conflict with sailing boats using the limited sandy foreshore area;
  - dive boats should be prevented from blocking ramps when loading / unloading passengers. Their occupation time of the facility was excessive;
  - trailer parking mixed with car parking generates problems. Needs better designation;
  - conflict with sailing boats using limited sandy foreshore area. Consider replacing undesirable rock edge south of ramp with sand;
  - a small boat harbour should be installed between Mattys Flat and Riverside Tavern;
  - wash down area near ramp creates bottlenecks; and
  - ideal if foreshore area was designated for water skiers only – i.e. no mooring within 100 metres.

#### 4.3.6 Back Creek

- the key issues raised with this ramp were associated with the accessibility of the creek and the bar. Dredging therefore was identified as a navigational priority by a number of stakeholders. This would require the preparation of an Environmental Impact Statement;
- the existing dredger operates entirely for commercial reasons and provides minimal navigational benefit;
- there were concerns that the Back Creek ramp area was not well maintained. Fish scraps were often discarded into creek creating health concerns on a swimming area only 200 metres away;
- other site improvements identified include the need for toilets, additional picnic facilities, and better car parking management (line marking); and
- rock adjacent to the ramp is dangerous and should be replaced with soft material or a structure for boat tying to facilitate disembarking of passengers. There is also a need to provide fill at end of ramp to overcome the existing vertical drop.

#### 4.3.7 Fishermans Reach

- the popularity of this site was well recognised by stakeholders and respondents from the local community. Despite having primitive facilities, use was considered to be growing – up to 10 boats plus / day. It is used largely for ocean going boats drawing a catchment of people north to Macksville and Nambucca where the facilities are unsatisfactory;
- the site was considered to be a high priority for upgrading with better facilities as it would take considerable pressure off the use of Stuarts Point boat ramp. River bank erosion from boat wash on the Macleay Arm could also be reduced if more boats were encouraged to use the ramp at Fishermans Reach rather than Stuarts Point; and
- there was a general view that boat users were respectful and observed speed limits.

#### 4.3.8 Stuarts Point

- the boat ramp has a strong association with the identity of Stuarts Point as a family based holiday destination. The area is also a big use of the waterway in summer by the Seventh Day Adventist Church for water skiing, sailing and canoeing. The nearby caravan park is busy all year round;
- the site offers no spare capacity during the peak in summer holidays. The boat ramp and car parking area was considered to work well during these periods. However, improvements to vehicle access and provision of facilities for easier boat handling were identified as desirable;
- the natural values of the Macleay Arm were highly regarded. The northern section of the Arm contains sea grass which requires careful management;
- riverside trawling is considered to be a big problem. For some respondents, ski boats and other commercial vessels have also reduced the amenity of the Macleay Arm north of Stuarts Point;

- skiing is popular along the eastern side of the Arm because of its available soft foreshores. There is concern that skiers are not compatible with other water based activities or conservation values of the area;
- the northern section of the Arm is very shallow and is generally only used by small boats and tinnies. The Fishermans Reach to Stuarts Point section of the Arm needs dredging as siltation is causing significant navigational problems especially at low tide;
- uncontrolled sewage discharge into the river is a serious health concern. There is a need for a reticulated sewerage system to be installed by the local authority; and
- there was concern that the existing 4 knot speed zone should be enforced to prevent erosion of the adjoining river bank.

# 5 Management Strategies

## 5.1 Discussion and Analysis

The outcomes of the site assessments and consultation processes have confirmed that boating is a highly popular recreational activity on the lower Macleay River Estuary. It is important to the lifestyle and identity of many who live in the area and is the main attraction for a large proportion of its visitors. Boating supports a broad range of commercial and tourism interests particularly in coastal communities where the local economy is heavily dependant on the local tourism industry. The provision of a quality network of boat ramps and associated infrastructure that meets the expectations of tourists and the local boating community will therefore be vital in sustaining boating interests as a driver of the region's long term economic viability.

Based on the community survey and stakeholder feedback, it is reasonable to assume that there are clearly defined usage patterns associated with boating access in the study area. These are largely determined by proximity to the ocean and form two broad categories of use:

- estuary based recreation which is generally favoured by users accessing the river at Stuarts Point and upstream of Jerseyville; and
- ocean based recreation which is strongly favoured by users of ramps within close proximity to the mouths of the Macleay River and Back Creek including Fishermans Reach, Mattys Flat, Back Creek ramp and Jerseyville ramp. These sites also attract a considerable number of estuary based users.

It is evident that the range of marine infrastructure and supporting facilities varies considerably between all of the sites along the estuary. Feedback from survey respondents and stakeholders broadly suggests, however, that the overall level of service provided by these facilities is inadequate. There is concern that improvements are essential to address substandard infrastructure and to ensure that the economic benefits derived from recreational boating will continue. The most pressing issue at most sites is the need for short term boat mooring facilities to enable safer and more convenient passenger transfer and access for single boat operators.

There is pressure to upgrade and expand facilities at sites where carrying capacities can often be exceeded. This is a significant issue at Mattys Flat and Stuarts Point which has minimal infrastructure. A response to these demands would ideally give due consideration to opportunities that may exist at other nearby sites where upgrades or changes to existing infrastructure may help off set demands on one key site. This strategic view may increase overall carrying capacity for the area and reduce conflicts that inevitably occur between different users in a concentrated setting.

Many of the ramps along the river estuary have primitive facilities and offer a very basic level of service. These ramps are predominantly former river punt approaches that have been adapted opportunistically for public boat launching without further embellishment of the original infrastructure. There is a need to upgrade the more popular ramps to optimise their locations for boat launching and to fully realise their potential for both water and land based recreation. The worthiness of retaining or upgrading other sites in the short term requires careful consideration in the context of achieving and maintaining an acceptable level of service at the more attractive locations.

There are a number of undeveloped riverside locations with no boat launching facilities that have been identified for investigation in the assessment. These offer a range of attributes and design opportunities that could be optimised to create new, purpose designed boat launching and riverside recreation areas. While this would provide considerable benefit to the boating and wider community, significant development and ongoing maintenance costs would present further, potentially unrealistic challenges to the limited resources of Kempsey Shire Council.

Navigational difficulties experienced by boat users resulting from siltation and weed growth are serious concerns to a large section of the boating community. It is clear that these issues have a direct impact on boating activity and in turn affect the function and value of the adjoining boat ramps and infrastructure. It seems essential, therefore, that decisions made on future management and infrastructure development of many boat ramps should be tied to the resolution of these problems.

While recreation boating is the focus of consideration for improved estuary access, there is also an expectation amongst survey respondents that the river foreshores should be made more available as a visual and cultural resource for the benefit of the broader community, particularly in Kempsey. Creating stronger links from the town centre, and possibly the Pacific Highway would increase the general usage of the foreshore area creating a more vibrant and safer public setting. This could be further stimulated by encouraging small scale and complementary commercial ventures such as boat hire operators and cafes. There is also a desire to provide facilities to enable a wider range of community events. These ideas have considerable merit in generating stronger public appreciation of the river, and in building community identity and social capital.

Community feedback indicates that there is strong support to improve environmental values of the estuary. In particular, there is concern to restore riparian vegetation along denuded banks of the main river channel and to protect existing remnant communities. Public boat launching areas present valuable opportunities in this regard as they have a high public profile and offer scope to incorporate revegetation work as part of a larger complementary upgrade program for optimal community benefit.

There is a need to identify the minimum infrastructure requirements that should be provided at launching areas to meet the expectations of users. This process should establish facilities that are necessary and can be shared by a wide range of users. Of equal importance is the need to determine uses that have unique requirements and where the nature of the activity is not likely to be compatible with other uses and may cause conflict.

## 5.2 Management Objectives

Based on the conclusions identified above, the following management objectives have been identified for the public boat launching sites in the lower Macleay River:

- ensure the long term sustainability of recreational boating as a key driver of the local economy;
- consider the needs of commercial fishers in the planning approval process for wharves, jetties and pontoons;
- provide an equitable distribution and number of launching facilities within the lower Macleay area that reflects the diversity of usage patterns and demands;
- provide a range of facilities and services that meets the expectations of the boating and wider community and that can be maintained at a high standard within the available resources of the local authority;
- give contextual consideration to the provision of improved marine infrastructure at particular sites in order to optimise the potential benefits of nearby areas; and
- ensure the ongoing use and management of marine infrastructure is environmentally sustainable.

## 5.3 Management Strategies

### 5.3.1 Commercial Fishing Requirements

Incorporate commercial fishing requirements into the planning approvals process for wharves, jetties and pontoons. This will involve the following steps:

- define areas within the Macleay River estuary that are regarded as high value fishing grounds for methods that could be impacted by pontoon, jetty or wharf development. This may be difficult as commercial fishers consider such information to be intellectual property;
- develop a system of screening proposed developments on or adjacent to waterways for potential impacts on estuarine fishing grounds;

- develop a protocol for consultation with local commercial fishers for the consideration of proposed developments where potential impacts on fishing grounds exist;
- incorporate the above systems into the local and state planning approvals process.

### 5.3.2 Boating Infrastructure Hierarchy

A hierarchy of sites has been identified to guide the distribution and associated range of facilities necessary to meet the requirements and expectations of the boating community within the lower Macleay River **(see Illustration 5.1).** Three categories have been identified to set a minimum standard of facility that should be anticipated at various sites along the river. Their number and distribution have generally been determined by demand, carrying capacity, existing infrastructure and the need to consolidate capital and maintenance costs. Several sites that should not be developed at this stage or should be decommissioned have also been highlighted.

### 5.3.3 Major Boating and Recreation Nodes

These locations will form the main hubs for riverside boating and recreation activity along the lower Macleay River Estuary. The nodes will be developed as key destinations with a range of site facilities that will complement the majority of requirements for boat launching as well as land-based recreation activities. The aim is to concentrate facilities and services where they will be most used and appreciated for the mutual benefit of the boating and wider community. This will ensure that they become busy, well maintained and highly attractive destinations that offer good passive surveillance and an enjoyable riverside experience for a broad range of users.

The distribution of the major sites has been determined largely by the existing demand for boat launching and to a lesser extent, riverside recreation. Accordingly, the majority of sites are located within close proximity to the coast and river mouth. The fewer upstream sites are less pressured by boating activity and were favoured because of their central location within a riverside community.

Most of the major sites identified already have well developed facilities and are recognised as key boat launching destinations. These may only require relatively minor upgrades to ensure that they offer a full complement of facilities. Other sites have little if any facilities and require significant development.

Major boating and recreation sites should offer the following minimum range of facilities and services (in accordance with Australian Standards):

1. Boating Infrastructure
    - sealed boat ramp and approach;
    - floating pontoon with possible jetty;
    - boat and fish cleaning facilities;
    - soft launching area; and
    - sealed car and trailer parking (in accordance with Australian Standards).

2. Site Amenities
    - managed open space within a natural riparian setting;
    - toilets;
    - lighting;
    - site interpretation;
    - playground;
    - picnic facilities; and
    - barbeques.

### 5.3.4 Secondary Boating and Recreation Sites

These sites are generally smaller in scale and offer a more limited range of boating and recreational infrastructure than the primary hubs. They will be recognised as important local riverside parks which generally reflect their existing status.

Secondary boating and recreation sites should offer the following minimum range of facilities and services:

1. Boating Infrastructure
   - sealed boat ramp and approach;
   - floating pontoon;
   - fish cleaning facilities; and
   - car and trailer parking (in accordance with Australian Standards).

2. Site Amenities
   - managed open space within a natural riparian setting;
   - lighting;
   - site interpretation; and
   - park furniture.

### 5.3.5 Primitive Launching Sites

The sites provide low key river access to remote locations where demand for formalised riverside recreation and marine infrastructure is minimal. They will cater to a small number of users seeking a quieter, less developed setting that offers strong natural values.

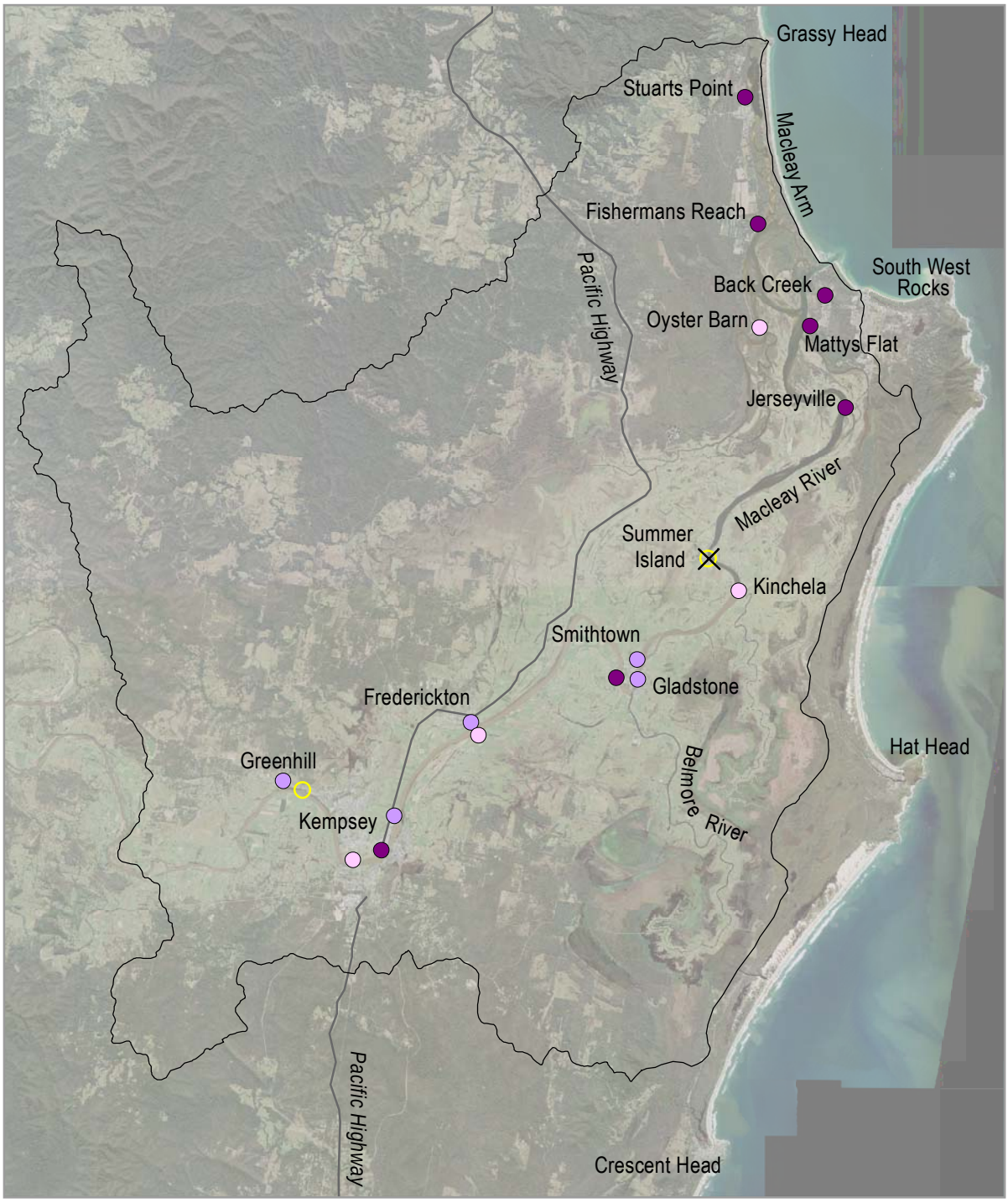
Infrastructure should include:

1. Boating Infrastructure
   - sealed boat ramp; and
   - informal car and trailer parking (maximum 5 spaces).

2. Site Amenities
   - natural riparian setting; and
   - site interpretation.

*Information shown is for illustrative purposes only*

*Drawn by: RE Reviewed by: MVE Date: May 2010*
*Source of base data: Kempsey Shire Council*




LEGEND

- Study area
- Major boating and recreation node
- Secondary boating and recreation site
- Primitive launching site
- Decommission
- Possible future development

North

0 5 km

# Boating Infrastructure Hierarchy

GeoLINK environmental management and design

Macleay River Marine Infrastructure Assessment
1481802

Illustration 5.1

## 5.4 Site Specific Strategies

The infrastructure hierarchy formed the basis of the following detailed recommendations for each of the investigation sites within the study area. The descriptions include site specific measures that may also be desirable to optimise particular site opportunities.

SITE CATEGORY:

M Major Node
S Secondary Site
P Primitive Site
F Future development site
D Decommissioned

| LOCATION | Category | SUGGESTED SITE IMPROVEMENTS | | |
|---|---|---|---|---|
| | | INFRASTRUCTURE | SITE AMENITIES | ENVIRONMENT |
| Site 1<br>Greenhill Boat Ramp | S | ▪ New floating pontoon or mooring piers to improve boat access and handling;<br>▪ Fill toe of ramp to improve boat launching and retrieval; and<br>▪ Incorporate controls on car movement to prevent unnecessary site impacts. | ▪ Consolidate and define extent of managed open space to terraced area;<br>▪ Upgrade picnic table, seat and shelter to new standard;<br>▪ Upgrade lighting to ramp and car park;<br>▪ New shade trees;<br>▪ New site interpretation and directional signage to generic standard. | ▪ Remove weed and restore riparian vegetation along embankment and around picnic and car park area. |
| Site 2<br>Greenhill Quarry | F | Investigate major infrastructure improvements over longer term when carrying capacities of other sites have been met and when local security concerns have been reduced. | | |
| Site 3<br>Railway Bridge, Kempsey | P | ▪ Incorporate controls on car movement to prevent unnecessary site impacts;<br>▪ Investigate opportunity to enhance foreshore area for soft launching;<br>▪ Upgrade and maintain gravel access road off Kemp Street. | Nil | ▪ Remove weeds and restore riparian vegetation along embankment and around car park area |

| LOCATION | Category | SUGGESTED SITE IMPROVEMENTS | | |
|---|---|---|---|---|
| | | INFRASTRUCTURE | SITE AMENITIES | ENVIRONMENT |
| Site 4<br>Riverside Park, Kempsey | M | ▪ Consider dredging of river channel and base of existing ramp to improve access in accordance with dredging protocol developed as part of Macleay River EMP;<br>▪ Install new pontoon and jetty to optimise use of main ramp;<br>▪ Investigate opportunity to enhance foreshore area for soft launching. | ▪ Undertake modifications to foreshore open spaces to facilitate community events and to generate a possible future cultural precinct;<br>▪ Strengthen pedestrian connections with CBD to enhance access for day use;<br>▪ New site interpretation and directional signage to generic standard.<br>▪ Improve lighting along key pedestrian connections;<br>▪ Encourage complimentary commercial ventures such as cafes and boat hire to increase site vibrancy and enhance security. | ▪ Any proposed dredging will require full review of environmental factors to facilitate work;<br>▪ Remove weed and restore riparian vegetation along foreshores. |
| Site 5<br>Forth Street, Kempsey | S | ▪ Construct new boat ramp and integrate with existing cul-de-sac;<br>▪ Install pontoon or mooring piers to facilitate boat access;<br>▪ New soft boat launching area and handling;<br>▪ Modify street layout to incorporate car / trailer parking. | ▪ New lighting along foreshores and street;<br>▪ New site interpretation and directional signage to integrate site with Riverside Park;<br>▪ Provide new area of managed open space with shade trees and picnic facilities to optimise attractive flat foreshore area. | ▪ Minimise disturbance to existing *Phragmites* beds on river bank as they provide buffer against erosion.<br>▪ Opportunity to consolidate *Phragmites* beds on toe of the river bank;<br>▪ Remove weed and restore riparian vegetation elsewhere through to Riverside Park. |
| Site 6<br>Fredericton North | S | ▪ Upgrade and seal ramp approach<br>▪ New floating pontoon or mooring piers to improve boat access and handling;<br>▪ Fill toe of ramp to improve boat launching and retrieval;<br>▪ Rationalise and improve configuration of car / trailer parking area;<br>▪ Provide direct and enhanced road access into site once highway bypass is in place | ▪ Establish new riverside park as an attractive community destination;<br>▪ Upgrade picnic tables, seat and shelter to new standard;<br>▪ Upgrade lighting to ramp and car park;<br>▪ New planting to screen adjoining residence and provide shade;<br>▪ New directional signage to strengthen connection with surrounding community;<br>▪ Investigate opportunities to interpret historic values and references of site and adjoining former industrial areas in park design | ▪ Minimise disturbance to existing *Phragmites* beds on river bank as they provide buffer against erosion;<br>▪ Remove weed and restore riparian vegetation elsewhere along embankment and around picnic and car park area; |

| LOCATION | Category | SUGGESTED SITE IMPROVEMENTS | | |
|---|---|---|---|---|
| | | INFRASTRUCTURE | SITE AMENITIES | ENVIRONMENT |
| Site 7<br>Frederickton South | P | ▪ Upgrade and seal ramp and approach;<br>▪ Define car / trailer parking area to minimise site impacts;<br>▪ Upgrade gravel access road<br>▪ Investigate opportunity to incorporate new soft boat launching area and handling; | ▪ New directional signage to improve connection from main road | ▪ Minimise disturbance to existing *Phragmites* beds on river bank as they provide buffer against erosion;<br>▪ Remove weed and restore riparian vegetation elsewhere along embankment |
| Site 8<br>Riverside Park, Smithtown | M | ▪ Construct new boat ramp and vehicular approach;<br>▪ New fish and boat cleaning facilities;<br>▪ Install floating pontoon to facilitate boat access;<br>▪ New soft boat launching area and handling;<br>▪ New access road and modify / provide new car park<br>▪ New soft boat launching area | ▪ Incorporate new riverside open spaces as an integral part of the existing parkland setting;<br>▪ Extend existing lighting to ramp and car park areas;<br>▪ New site interpretation and directional signage;<br>▪ Create new pedestrian path system to create continuous foreshore connection to neighbouring residential areas. | ▪ Remove weed and restore riparian vegetation along embankment to integrate with existing revegetation work |
| Site 9<br>Wharf Reserve, Gladstone | S | ▪ Investigate options to incorporate new temporary mooring facilities onto existing platform. | ▪ Upgrade signage to strengthen pedestrian orientation and direction. | ▪ Incorporate new riparian vegetation into existing managed grassed embankment. |
| Site 10<br>Smithtown Boat Ramp | S | ▪ Define car / trailer parking area to minimise site impacts;<br>▪ New fish cleaning facilities | ▪ Upgrade site and adjoining parkland area with new shade trees and screen planting to create a more attractive community setting. | ▪ Remove weed and restore riparian vegetation along embankment. |
| Site 11<br>Summer Island | D | Consider removal of ramp from public use due to hazardous site access and limited opportunity to provide acceptable facilities. | | ▪ Remove weed and restore riparian vegetation along embankment. |
| Site 12<br>Kinchela | P | ▪ Resurface ramp and approach;<br>▪ Upgrade gravel access road;<br>▪ Investigate opportunity to incorporate new soft boat launching area and handling. | ▪ Upgrade riverside vegetation to create an attractive continuous riverside corridor on either side of the road bridge. | ▪ Remove weed and restore riparian vegetation along embankment and access road. |
| Site 13<br>Jerseyville Boat Ramp | M | ▪ New floating pontoon to improve boat access and handling;<br>▪ Review car / trailer parking layout to ensure site requirements are met and to minimise site impacts. | ▪ Upgrade setting as an attractive community destination with significant new shade tree and shelter planting;<br>▪ New playground;<br>▪ Consider modifying design of existing revegetation work to improve pedestrian integration and optimise site design | ▪ Opportunity to expand existing riparian zone revegetation work on upstream embankment;<br>▪ Restore riparian vegetation along embankment adjacent to site. |

| LOCATION | Category | SUGGESTED SITE IMPROVEMENTS | | |
|---|---|---|---|---|
| | | INFRASTRUCTURE | SITE AMENITIES | ENVIRONMENT |
| | | | opportunities;<br>▪ Upgrade picnic tables, seats and shelters to new standard;<br>▪ Upgrade lighting throughout; and<br>▪ New site interpretation and directional signage to generic standard. | |
| Site 14<br>Oyster Barn | P | ▪ Investigate opportunity to upgrade site for soft boat launching area and handling<br>▪ Incorporate controls on car movement to prevent unnecessary site impacts | | ▪ Incorporate a low wake zone and undertake measures to minimise physical disturbance to existing salt marsh and mangrove habitat. |
| Site 15<br>Mattys Flat | M | Undertake improvements and measures in accordance with Plan of Management | | |
| Site 16<br>Back Creek | M | ▪ New floating pontoon to improve boat access and handling;<br>▪ Rationalise car / trailer parking area to minimise site impacts. | ▪ New toilet block<br>▪ Improve layout to establish site as an integral part of the adjoining parkland setting<br>▪ New site interpretation and directional signage to generic standard;<br>▪ New picnic tables, seat and shelters to new standard. | ▪ Protect existing remnant riparian and seagrass habitat;<br>▪ Undertake full review of environmental factors to facilitate dredging;<br>▪ Incorporate best practice boating signage. |
| Site 17<br>Fishermans Reach | M | ▪ Upgrade boat ramp and vehicular approach;<br>▪ New fish and boat cleaning facilities;<br>▪ Install floating pontoon to facilitate boat access;<br>▪ New access road and car park;<br>▪ New soft boat launching area and handling. | ▪ Incorporate new managed open spaces and riverside recreation area;<br>▪ New lighting to ramp and car park areas;<br>▪ New site interpretation and directional signage;<br>▪ Consider new playground over longer term;<br>▪ Consider new toilet block over longer term. | ▪ Protect and enhance extent of existing intact riparian vegetation;<br>▪ Incorporate best practice boating signage. |
| Site 18<br>Stuarts Point | M | ▪ Rationalise car / trailer parking area to minimise site impacts. | ▪ Improve layout to establish site as an integral part of the adjoining parkland setting;<br>▪ New site interpretation and directional signage to generic standard. | ▪ Protect and enhance extent of existing intact riparian vegetation;<br>▪ Incorporate best practice boating signage. |

**Table 5.1 Summary of Proposed Infrastructure Improvements**

| | Greenhill Boat Ramp | Greenhill Quarry | Railway Bridge | Riverside Park | Forth Street | *Frederickton North | Frederickton South | Riverside Park, Smithtown | Wharf Reserve, Gladstone | Smithtown Boat Ramp | Summer Island | Kinchela | Jerseyville Boat Ramp | Oyster Barn | Mattys Flat* | Back Creek | Fishermans Reach | Stuarts Point |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BOAT LAUNCH SITE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| SITE CATEGORY | | | | | | | | | | | | | | | | | | |
| GENERAL STRATEGY | | | | | | | | | | | | | | | | | | |
| Decommission / retain as is | | | | | | | | | | | | | | | | | | |
| Undertake minor improvements | | | | | | | | | | | | | | | | | | |
| Undertake major new work | | | | | | | | | | | | | | | | | | |
| INFRASTRUCTURE IMPROVEMENTS | | | | | | | | | | | | | | | | | | |
| Ramp repair / resurface | | | | | | | | | | | | | | | | | | |
| Undertake dredging work | | | | | | | | | | | | | | | | | | |
| New ramp | | | | | | | | | | | | | | | | | | |
| Fill below toe of ramp | | | | | | | | | | | | | | | | | | |
| New pontoon / jetty / mooring | | | | | | | | | | | | | | | | | | |
| New / upgrade parking | | | | | | | | | | | | | | | | | | |
| Upgrade road access | | | | | | | | | | | | | | | | | | |
| New boat / fish cleaning | | | | | | | | | | | | | | | | | | |
| Upgrade for soft launching | | | | | | | | | | | | | | | | | | |
| SITE AMENITY IMPROVEMENTS | | | | | | | | | | | | | | | | | | |
| Redesign / modify site layout | | | | | | | | | | | | | | | | | | |
| Provide / upgrade open spaces | | | | | | | | | | | | | | | | | | |
| Provide / upgrade lighting | | | | | | | | | | | | | | | | | | |
| Provide / upgrade toilets | | | | | | | | | | | | | | | | | | |
| New / upgraded picnic facilities | | | | | | | | | | | | | | | | | | |
| New playground | | | | | | | | | | | | | | | | | | |
| Improve site interpretation | | | | | | | | | | | | | | | | | | |
| Improve pedestrian connection | | | | | | | | | | | | | | | | | | |
| Shade trees and screen plants | | | | | | | | | | | | | | | | | | |
| Weed removal / revegetation | | | | | | | | | | | | | | | | | | |

SITE CATEGORY
Major Node
Secondary Site
Primitive Site

PRIORITY FOR IMPROVEMENTS
High
Low

* All proposed new work to be in accordance with Mattys Flat Plan of Management

* Recommendations to upgrade the Frederickton Ramp to 'Secondary Site' standard should be applied as a minimum to any new replacement facility that may be built by the RTA as part of the Pacific Highway upgrade.

# 6

# Conclusions

This study establishes draft management strategies that have been recommended for the 18 investigation sites along the lower Macleay River estuary. These have been incorporated as a component of the Draft Estuary Management Study which will be subject to a further round of community consultation. Following input from this process, the draft strategies will be amended where necessary and developed further as part of the preparation of an Estuary Management Plan. This next stage will identify strategy priorities, a detailed implementation action plan, estimated costs, responsibilities, funding sources and timeframes. Concept plans for three key sites will also be generated to demonstrate their design potential through the implementation of the recommended management strategies.

# Project Team

The project team members included:

**GeoLINK**
Garry Murray
Richard Elliott
Tim Ruge

**Aquatic Science and Management**
Matthew Birch

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# Appendix A1

## Copy of Boating Survey questionnaire

KEMPSEY SHIRE COUNCIL

Macleay River Estuary Management Study and Plan

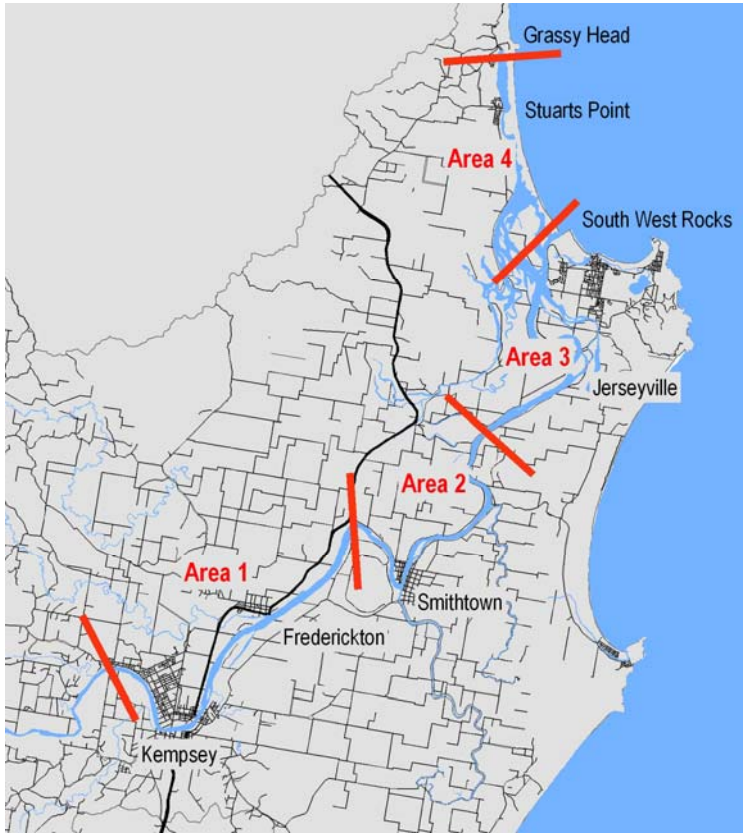
# COMMUNITY SURVEY

Kempsey Shire Council in association with the Department of Environment Climate Change & Water, NSW Maritime and consultants GeoLINK, GECO Environmental, and Aquatic Science & Management is preparing an Estuary Management Study and Plan for the Macleay River.

The study will examine the critical processes, threats and uses of the river including boating, fishing, river and foreshores access, riverbank erosion, protection of floodplain wetlands and water quality issues. A detailed boating assessment is also being undertaken concurrently to improve the general understanding of boating usage patterns and management requirements.

Study outcomes will provide direction for sustainable management of the estuary and possible future capital works including improved boat launching facilities, bank restoration, possible fishing sanctuary zones and protection of significant wetland areas.

Stakeholder and community participation is vital to the success of the Plan.




## Please take this opportunity to participate in the study by completing this survey

You can lodge your completed survey by:

- Hand: In the collection box at a survey venue
- Post: GeoLINK, PO Box 1446 Coffs Harbour NSW 2450
- Facsimile: 02 6651 7733
- Email: Macleay.estuary.study@geolink.net.au

## Survey forms must be received by Friday 5 February 2010

Macleay River Estuary Management Study and Plan

# General Community Survey

1. Are you a resident in one of the following precincts within the Study Area (refer to map)?

| ☐ Macleay Arm Area Grassy Head / Stuarts Point / Fishermans Reach / Clybucca (Area 4) | ☐ Macleay River Entrance Area: South West Rocks / Jerseyville (Area 3) | ☐ Middle Reach Area: Kinchella / Gladstone / Smithtown (Area 2) | ☐ Upper Reach Area: Fredrickton / Kempsey / Greenhill (Area 1) |
|---|---|---|---|

Please provide your postcode: ☐

2. If not, where are you from?

| ☐ Elsewhere within the Kempsey Council Area | ☐ Port Macquarie – Hastings Council Area | ☐ Nambucca Council Area | ☐ Elsewhere on the Mid North Coast | ☐ Other area in NSW | ☐ Interstate / Overseas |
|---|---|---|---|---|---|

Please provide your postcode if you are from Australia: ☐

3. Please indicate how you use the Macleay River estuary area ... (tick one or more boxes)

| ☐ Boating (please also complete the attached Recreation Boating Community Survey) | ☐ Swimming | ☐ Picnicking / Walking | ☐ Farming on the floodplain |
|---|---|---|---|
| ☐ Recreational Fishing | ☐ Commercial Fishing | ☐ Aquaculture | ☐ Other (please describe) …. |

4. Please indicate the importance you place on the following estuary related values…

*Your answers will help focus the future management of the estuary area.*

| | Very Important | Important | Not Important | Don't Know |
|---|---|---|---|---|
| Boating activities within the estuary (please also complete the attached Recreation Boating Community Survey) | ☐ | ☐ | ☐ | ☐ |
| Easy navigation of the river and Macleay Arm by boat (please also complete the attached Recreation Boating Community Survey) | ☐ | ☐ | ☐ | ☐ |
| The ability to fish within the estuary | ☐ | ☐ | ☐ | ☐ |
| Vehicle or pedestrian access to the river for non-boating activities eg. picnicking / walking | ☐ | ☐ | ☐ | ☐ |
| Walking access along the river | ☐ | ☐ | ☐ | ☐ |
| Riverside tourist accommodation | ☐ | ☐ | ☐ | ☐ |
| Attraction to tourists | ☐ | ☐ | ☐ | ☐ |
| Safe swimming locations | ☐ | ☐ | ☐ | ☐ |
| Protecting the riverbanks from erosion | ☐ | ☐ | ☐ | ☐ |
| Native riverside vegetation | ☐ | ☐ | ☐ | ☐ |
| Floodplain backswamps / wetlands | ☐ | ☐ | ☐ | ☐ |
| Good water quality in the river | ☐ | ☐ | ☐ | ☐ |
| Oyster growing | ☐ | ☐ | ☐ | ☐ |
| Historical / cultural values | ☐ | ☐ | ☐ | ☐ |

5. What other features of Macleay River are important to you?

*(Please describe)*

Macleay River Estuary Management Study and Plan

# General Community Survey

6. Are you happy with current access arrangements to the river, its creeks and adjoining banks?

*(Indicate Yes/No & comment)*

| | Yes | No | |
|---|---|---|---|
| Boat ramps | ☐ | ☐ | *Comment:* |
| Vehicle access | ☐ | ☐ | *Comment:* |
| Pedestrian access | ☐ | ☐ | *Comment:* |
| Disabled access | ☐ | ☐ | *Comment:* |

7. How would you rate the health of Macleay River in regard to ...

| | Very Poor | Poor | Moderate | Good | Very Good |
|---|---|---|---|---|---|
| Water quality | ☐ | ☐ | ☐ | ☐ | ☐ |
| Fish populations / aquatic ecosystems | ☐ | ☐ | ☐ | ☐ | ☐ |
| Riverside vegetation | ☐ | ☐ | ☐ | ☐ | ☐ |
| Bank stability | ☐ | ☐ | ☐ | ☐ | ☐ |
| Navigation | ☐ | ☐ | ☐ | ☐ | ☐ |
| Floodplain backswamps | ☐ | ☐ | ☐ | ☐ | ☐ |
| Oyster harvest areas | ☐ | ☐ | ☐ | ☐ | ☐ |

8. What, if any, issues or impacts do you think affect the health of the Macleay River estuary?

*(Please describe)*

9. Would you support the creation of fishing sanctuary zones in some critical locations?

| Strongly Support | Moderately Support | Do Not Support | Don't Know |
|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ |

10. Are any of the following issues of concern to you?

| | Very Concerned | Concerned | Un-concerned | Don't Know |
|---|---|---|---|---|
| Urban / residential development along the river edge | ☐ | ☐ | ☐ | ☐ |
| Commercial / industrial development along the river edge | ☐ | ☐ | ☐ | ☐ |
| Bank erosion | ☐ | ☐ | ☐ | ☐ |
| Lack of riverside vegetation | ☐ | ☐ | ☐ | ☐ |
| Overfishing | ☐ | ☐ | ☐ | ☐ |
| Acid sulfate soils | ☐ | ☐ | ☐ | ☐ |
| Lack of habitat protection | ☐ | ☐ | ☐ | ☐ |
| Degraded floodplain backswamps / wetlands | ☐ | ☐ | ☐ | ☐ |
| Spread of aquatic weeds | ☐ | ☐ | ☐ | ☐ |
| Sea level rise and climate change | ☐ | ☐ | ☐ | ☐ |
| Operation of floodgates and drainage works | ☐ | ☐ | ☐ | ☐ |
| Dredging of the river | ☐ | ☐ | ☐ | ☐ |
| Poor water quality and fish kills after flooding | ☐ | ☐ | ☐ | ☐ |
| Protection of the shellfish industry | ☐ | ☐ | ☐ | ☐ |
| Scenic amenity | ☐ | ☐ | ☐ | ☐ |
| Cultural heritage (indigenous) | ☐ | ☐ | ☐ | ☐ |
| Inadequate treatment of stormwater and effluent | ☐ | ☐ | ☐ | ☐ |
| Other *(please describe)* | ☐ | ☐ | ☐ | ☐ |

11. Are there any other comments you would like to make?

Macleay River Estuary Management Study and Plan

# Recreation Boating Community Survey

1. Are you a resident in one of the following precincts within the Study Area (refer to map)?

| ☐ Macleay Arm Area Grassy Head / Stuarts Point / Fishermans Reach / Clybucca (Area 4) | ☐ Macleay River Entrance Area: South West Rocks / Jerseyville (Area 3) | ☐ Middle Reach Area: Kinchella / Gladstone / Smithtown (Area 2) | ☐ Upper Reach Area: Fredrickton / Kempsey / Greenhill (Area 1) |
|---|---|---|---|

Please provide your postcode: ☐

2. If not, where are you from?

| ☐ Elsewhere within the Kempsey Council Area | ☐ Port Macquarie – Hastings Council Area | ☐ Nambucca Council Area | ☐ Elsewhere on the Mid North Coast | ☐ Other area in NSW | ☐ Interstate / Overseas |
|---|---|---|---|---|---|

Please provide your postcode if you are from Australia: ☐

3. What do you use your vessel for … (tick one or more boxes):

☐ Private / Recreational ☐ Business / charter

4. What is your primary boating activity?

☐ Recreational boating
☐ Charter – Dive
☐ Charter- Fishing
☐ Charter - recreational
☐ Commercial Fishing
☐ Competitive event (please specify)
☐ Recreational Fishing
☐ Paddling
☐ Water skiing
☐ Jet skiing
☐ Accessing other riverside destinations
☐ Other (please specify)

5. What type/size of vessel do you use?

Please indicate size of vessel

| | 0 – 5m | 5 – 8m | 8 – 12m | 12m and over |
|---|---|---|---|---|
| ☐ Cabin runabout | ☐ | ☐ | ☐ | ☐ |
| ☐ Motor Cruiser | ☐ | ☐ | ☐ | ☐ |
| ☐ Canoe/kayak | ☐ | ☐ | ☐ | ☐ |
| ☐ Houseboat | ☐ | ☐ | ☐ | ☐ |
| ☐ Inflatable | ☐ | ☐ | ☐ | ☐ |
| ☐ Open runabout(tinny) | ☐ | ☐ | ☐ | ☐ |
| ☐ Paddle (Row) Boat | ☐ | ☐ | ☐ | ☐ |
| ☐ Personal Watercraft (Jet Ski) | ☐ | ☐ | ☐ | ☐ |
| ☐ Sailing Vessel | ☐ | ☐ | ☐ | ☐ |
| ☐ Other (please specify) | ☐ | ☐ | ☐ | ☐ |

6. Where do generally launch from ?

☐ Grassy Head ☐ Stuarts Point ☐ Fishermans Reach
☐ Mattys Flat ☐ Jerseyville ☐ Other (please describe)….

**7.** Where do you take your boat once it is launched?

| ☐ On the river but remain within the same precinct (up to 5km distance) | ☐ On the river but travel some distance (over 5km) into other precincts | ☐ Onto the ocean |
|---|---|---|

8. How often do you access the river for boating?

☐ Daily ☐ Weekly ☐ Monthly ☐ Yearly ☐ Other (please specify)

Macleay River Estuary Management Study and Plan

# Recreation Boating Community Survey

9. How do you compare the natural aspects of the Macleay River for recreational boating with other coastal river systems?

☐ Much preferred ☐ Similar ☐ Least favoured

10. How do you compare the facilities and boating infrastructure on the Macleay River with other coastal river systems?

☐ Much preferred ☐ Similar ☐ Least favoured

11. What do you think about the existing Navigation Aids?

| | Agree | Disagree | Don't Know |
|---|---|---|---|
| They are of a good standard | ☐ | ☐ | ☐ |
| They adequately assist with general navigation of the river | ☐ | ☐ | ☐ |

12. What do you value about the river in its present state?

| | Very Important | Important | Not Important | Don't Know |
|---|---|---|---|---|
| Natural environment and scenic quality (ie sense of uniqueness, riparian vegetation, open/ enclosed water settings, distant views, native fauna) | ☐ | ☐ | ☐ | ☐ |
| Recreational Opportunities (ie diversity of water based experiences) | ☐ | ☐ | ☐ | ☐ |
| Ability to pursue activities on the river in a fair and equitable manner | ☐ | ☐ | ☐ | ☐ |
| Protection of the river banks | ☐ | ☐ | ☐ | ☐ |
| Adequacy of boating infrastructure | ☐ | ☐ | ☐ | ☐ |
| Safety | ☐ | ☐ | ☐ | ☐ |
| Amenity (proximity to services, ease of access, facilities to support boating activity) | ☐ | ☐ | ☐ | ☐ |

13. What do you believe are the key issues that impact on recreation boating in the river?

| | Very Significant | Significant | Not Significant | Don't Know |
|---|---|---|---|---|
| Inadequate boat storage and key infrastructure (ie ramps, moorings, jetties, pontoons, boat harbour, parking) | ☐ | ☐ | ☐ | ☐ |
| Inadequate supplementary boating facilities (wash down areas, sewerage and rubbish collection, commercial services) | ☐ | ☐ | ☐ | ☐ |
| Availability and quality of visitor facilities (picnic areas, toilets, open space) | ☐ | ☐ | ☐ | ☐ |
| Inadequate launching access to alternative parts of the river (road connections, private property, difficult physical conditions) | ☐ | ☐ | ☐ | ☐ |
| Disused oyster beds impacting on safe navigation | ☐ | ☐ | ☐ | ☐ |
| Difficult navigation of the river due to limited depth in certain locations (please specify below the locations where you experience difficulty) | ☐ | ☐ | ☐ | ☐ |
| Loss of amenity (excessive and / or conflicting uses, poor infrastructure maintenance, irresponsible/antisocial behaviour) | ☐ | ☐ | ☐ | ☐ |
| Environmental protection (damaging uses, loss of biodiversity and habitat, water quality) | ☐ | ☐ | ☐ | ☐ |
| Safety and security (floods, currents, vandals, conflicts between users, emergency response) | ☐ | ☐ | ☐ | ☐ |

Difficult navigation locations due to limited depth:
(please specify eg. between Fishermans Reach and Stuarts Point)

14. What is your vision for creating a more attractive recreational boating environment within the Macleay River? (please specify)

15. Are there any comments you would like to make?

# Appendix B1

## Boating survey results

## BOATING SURVEY SUMMARY

| | |
|---|---|
| **TOTAL NUMBER OF RESPONSES** | **131** |
| **1. Are you a resident in one of the following precincts within the Study Area (refer to map)?** | |
| Macleay Arm Area Grassy Head / Stuarts Point / Fishermans Reach / Clybucca (Area 4) | 48 |
| Macleay River Entrance Area: South West Rocks / Jerseyville (Area 3) | 26 |
| Middle Reach Area: Kinchella / Gladstone / Smithtown (Area 2) | 12 |
| Upper Reach Area: Fredrickton / Kempsey / Greenhill (Area 1) | 26 |
| Please provide your postcode: | |
| **2. If not, where are you from?** | |
| Elsewhere within the Kempsey Council Area | 8 |
| Port Macquarie – Hastings Council Area | 4 |
| Nambucca Council Area | 2 |
| Elsewhere on the Mid North Coast | 2 |
| Other area in NSW | 1 |
| Interstate / Overseas | 2 |
| Please provide your postcode if you are from Australia: | |
| **3. What do you use your vessel for … (tick one or more boxes):** | |
| Private / Recreational | 117 |
| Business / charter | 3 |
| **4. What is your primary boating activity?** | |
| Recreational boating | 64 |
| Charter – Dive | 0 |
| Charter- Fishing | 1 |
| Charter - recreational | 1 |
| Commercial Fishing | 2 |
| Competitive event (please specify) | 6 |
| *Comment* | |
| Recreational Fishing | 97 |
| Paddling | 36 |
| Water skiing | 7 |
| Jet skiing | 4 |
| Accessing other riverside destinations | 19 |
| Other (please specify) | 14 |
| *Comment* | |

**5. What type/size of vessel do you use?**

| **Size of Vessel: 0-5m= 1, 5-8m = 2, 8-12m = 3 & 12m and over = 4** | 0-5 m | 5-8 m | 8-12 m | 12 m & over |
|---|---|---|---|---|
| Cabin runabout | 10 | 10 | 1 | 0 |
| Motor Cruiser | 1 | 3 | 2 | 1 |
| Canoe/kayak | 42 | 2 | 1 | 0 |
| Houseboat | 0 | 0 | 2 | 0 |
| Inflatable | 4 | 0 | 0 | 0 |
| Open runabout(tinny) | 68 | 6 | 1 | 0 |
| Paddle (Row) Boat | 10 | 1 | 1 | 0 |
| Personal Watercraft (Jet Ski) | 1 | 0 | 0 | 0 |
| Sailing Vessel | 0 | 3 | 1 | 0 |
| Other (please specify) | 2 | 2 | 1 | 3 |
| *Comment* | 0 | 0 | 0 | 0 |

| | |
|---|---|
| **6. Where do generally launch from ?** | |
| Grassy Head | 12 |
| Mattys Flat | 17 |
| Stuarts Point | 32 |
| Jerseyville | 34 |
| Fishermans Reach | 43 |
| Other (please describe)…. | 53 |
| **7. Where do you take your boat once it is launched?** | |
| On the river but remain within the same precinct (up to 5km distance) | 78 |

| | |
|---|---|
| On the river but travel some distance (over 5km) into other precincts | 50 |
| Onto the ocean | 38 |

**8. How often do you access the river for boating?**

| | |
|---|---|
| Daily | 9 |
| Weekly | 59 |
| Monthly | 45 |
| Yearly | 7 |
| Other (please specify) | 11 |

**9. How do you compare the natural aspects of the Macleay River for recreational boating with other coastal river systems?**

| | |
|---|---|
| Much preferred | 35 |
| Similar | 73 |
| Least favoured | 13 |

**10. How do you compare the facilities and boating infrastructure on the Macleay River with other coastal river systems?**

| | |
|---|---|
| Much preferred | 14 |
| Similar | 66 |
| Least favoured | 38 |

**11. What do you think about the existing Navigation Aids?**

| **Agree = 1, Disagree = 2 & Don't Know = 3** | Agree | Disagree | Don't Know |
|---|---|---|---|
| They are of a good standard | 74 | 24 | 24 |
| They adequately assist with general navigation of the river | 83 | 22 | 20 |

**12. What do you value about the river in its present state?**

| **Very Important = 1, Important = 2, Not Important = 3 & Don't Know = 4** | Very Important | Important | Not Important | Don't Know |
|---|---|---|---|---|
| Natural environment and scenic quality (ie sense of uniqueness, riparian vegetation, open/ enclosed water settings, distant views, native fauna) | 80 | 40 | 6 | 0 |
| Recreational Opportunities (ie diversity of water based experiences) | 70 | 48 | 6 | 1 |
| Ability to pursue activities on the river in a fair and equitable manner | 81 | 42 | 2 | 1 |
| Protection of the river banks | 76 | 45 | 2 | 1 |
| Adequacy of boating infrastructure | 60 | 50 | 11 | 3 |
| Safety | 79 | 40 | 5 | 2 |
| Amenity (proximity to services, ease of access, facilities to support boating activity) | 63 | 47 | 15 | 1 |

**13. What do you believe are the key issues that impact on recreation boating in the river?**

| **Very Significant = 1, Significant = 2, Not Significant = 3 & Don't Know = 4** | Very Significant | Significant | Not Significant | Don't know |
|---|---|---|---|---|
| Inadequate boat storage and key infrastructure (ie ramps, moorings, jetties, pontoons, boat harbour, parking) | 62 | 34 | 26 | 5 |
| Inadequate supplementary boating facilities (wash down areas, sewerage and rubbish collection, commercial services) | 65 | 40 | 18 | 5 |
| Availability and quality of visitor facilities (picnic areas, toilets, open space) | 58 | 52 | 17 | 1 |
| Inadequate launching access to alternative parts of the river (road connections, private property, difficult physical conditions) | 49 | 35 | 34 | 6 |
| Disused oyster beds impacting on safe navigation | 44 | 34 | 37 | 11 |
| Difficult navigation of the river due to limited depth in certain locations (please specify below the locations where you experience difficulty) | 60 | 33 | 33 | 3 |
| Loss of amenity (excessive and / or conflicting uses, poor infrastructure maintenance, irresponsible/antisocial behaviour) | 45 | 43 | 29 | 6 |
| Environmental protection (damaging uses, loss of biodiversity and habitat, water quality) | 70 | 47 | 4 | 1 |
| Safety and security (floods, currents, vandals, conflicts between users, emergency response) | 59 | 40 | 15 | 6 |
| Difficult navigation locations due to limited depth: (please specify eg. between Fishermans Reach and Stuarts Point) | 59 | 0 | 0 | 0 |
| *Comment* | | | | |

**14. What is your vision for creating a more attractive recreational boating environment within the Macleay River? (please specify)**

**15. Are there any comments you would like to make?**

# Appendix B

## Priority Weeds For Management In The Macleay Estuary Area

**Table B1 Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) and Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) priority weeds relevant to the Macleay Estuary Area**

| Common Name | Scientific Name | Known Occurrences in Macleay Estuary Area | Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) | | Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) | |
|---|---|---|---|---|---|---|
| | | | Priority | Landscape | Priority | Landscape |
| Oleander | - | No | Not prioritised | Urban | - | - |
| Rubber Tree | - | No | Not prioritised | Coastal | - | - |
| Thistle | - | Yes | D | Agricultural | - | - |
| Karoo Thorn | *Acacia karroo* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| Prickly Acacia | *Acacia nilotica* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| **Turkey Rhubarb** | ***Acetosa sagittata*** | No | - | - | D | Coastal Landscapes |
| Aciacia Saligna | *Aciacia saligna* | No | B | Coastal | - | - |
| Crofton Weed | *Ageratina adenophora* | Yes | C (Agricultural)<br>D (Forest)<br>Not prioritised (Riparian) | Agricultural, Forest, Riparian | - | - |
| Mistflower | *Ageratina riparia* | No | Not prioritised (Riparian) | Riparian | D | (Lowland) Riparian Landscapes |
| Alligator Weed | *Alternanthera philoxeroides* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | Aa | Aquatic Landscapes |
| Pond Apple | *Annona glabra* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| **Madeira Vine** | ***Anredera cordifolia*** | Yes | B (Coastal)<br>C (Forest, Riparian, Urban) | Coastal, Forest, Riparian, Urban | C | (Lowland) Forest Landscapes<br>(Lowland) Riparian Landscapes |

| Common Name | Scientific Name | Known Occurrences in Macleay Estuary Area | Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) | | Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) | |
|---|---|---|---|---|---|---|
| | | | Priority | Landscape | Priority | Landscape |
| **Moth Vine** | ***Araujia sericifera*** | Yes | Not prioritised | Coastal, Forest | E | (Lowland) Forest Landscapes<br>(Lowland) Riparian Landscapes |
| **Dutchmans Pipe** | ***Aristolochia elegans*** | No | - | - | C | (Lowland) Riparian Landscapes |
| **Ground/Basket Asparagus** | ***Asparagus aethiopicus*** | Yes | D (Coastal)<br>Not prioritised (Urban) | Coastal, Urban | C | Coastal Landscapes<br>(Lowland) Forest Landscapes<br>(Lowland) Urban Landscapes |
| **Asparagus Fern** | ***Asparagus africanus*** | No | C (Forest)<br>D (Coastal)<br>Not prioritised (Urban) | Coastal, Urban | - | - |
| **Bridal Creeper** | ***Asparagus asparagoides*** | No | Not prioritised (Urban) | Urban | Aa | (Lowland) Forest Landscapes |
| **Climbing Asparagus** | ***Asparagus plumosus*** | Yes | D | Coastal | C | Coastal Landscapes<br>(Lowland) Forest Landscapes |
| **Chinese Violet** | ***Asystasia gangetica ssp micrantha*** | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| Groundsel Bush | *Baccharis halimifolia* | Yes | A (Urban)<br>B (Agricultural, Coastal)<br>C (Forest, Riparian) | Agricultural, Coastal, Forest, Urban, Riparian | B | Coastal Landscapes |
| Kochia | *Bassia scoparia / Kochia scoparia* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| Devils Trumpet | *Brugmansia* x *candida* | No | A (Riparian)<br>B (Urban) | Riparian | Aa | (Lowland) Urban Landscapes |
| Mother-of-millions | *Bryophyllum delagoense* | Yes | - | - | B | Coastal Landscapes |

| Common Name | Scientific Name | Known Occurrences in Macleay Estuary Area | Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) | | Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) | |
|---|---|---|---|---|---|---|
| | | | Priority | Landscape | Priority | Landscape |
| Mother-of-millions | *Bryophyllum delagoense* | Yes | - | - | E | Agricultural Landscapes |
| Mother-of-millions/ Resurrection Plant | *Bryophyllum spp.* | Yes | B (Agricultural)<br>C (Agricultural, Coastal, Forest, Riparian) | Agricultural, Coastal, Forest, Riparian | B | Coastal Landscapes |
| Cabomba | *Cabomba caroliniana* | No | B | Riparian | Aa | Aquatic Landscapes |
| **Mysore Thorn** | ***Caesalpinia decapetala*** | No | B | Coastal, Forest, Riparian | B | (Lowland) Forest Landscapes<br>(Lowland) Riparian Landscapes |
| Canna Lily | *Canna indica* | No | Not prioritised | Urban | D | (Lowland) Urban Landscapes |
| **Balloon Vine** | ***Cardiospermum grandiflorum*** | Yes | B | Forest, Riparian | C | (Lowland) Riparian Landscapes |
| Nodding Thistle | *Carduus nutans subsp. Nutans* | No | - | - | Aa | Agricultural Landscapes |
| Saffron Thistle | *Carthamus lanatus* | No | - | - | Aa | Agricultural Landscapes |
| Gold Dodder | *Cascuta campestris* | No | B (Agricultural)<br>C (Riparian) | Agricultural, Riparian | - | - |
| Celtis | *Celtis sinensis* | No | A (Riparian)<br>B (Urban) | Riparian, Urban | Aa | (Lowland) Forest Landscapes<br>(Lowland) Riparian Landscapes<br>(Lowland) Urban Landscapes |
| Spiny Burrgrass | *Cenchrus incertus/C. longispinus* | No | B | Coastal | - | - |
| Star Thistle | *Centaurea calcitrapa* | No | - | - | Aa | Agricultural Landscapes |
| Spotted Knapweed | *Centaurea maculosa* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |

| Common Name | Scientific Name | Known Occurrences in Macleay Estuary Area | Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) | | Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) | |
|---|---|---|---|---|---|---|
| | | | Priority | Landscape | Priority | Landscape |
| Black Knapweed | *Centaurea nigra* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| Green Cestrum | *Cestrum parqui* | No | B (Agricultural, Riparian)<br>C (Urban) | Agricultural, Riparian, Urban | B | Coastal Landscapes<br>(Lowland) Urban Landscapes |
| Night Jasamine | *Cestrum nocturnum* | No | Not prioritised | Riparian | - | - |
| Siam Weed | *Chromolaena odorata* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| **Bitou Bush** | ***Chrysanthemoides monilifera*** | Yes | D | Coastal | D | Coastal Landscapes |
| Camphor Laurel | *Cinnamomum camphora* | Yes | Not prioritised | Riparian, Urban | C | (Lowland) Forest Landscapes<br>(Lowland) Riparian Landscapes<br>(Lowland) Urban Landscapes |
| Taro | *Colocasia esculenta* | Yes | B | Urban | B | Aquatic Landscapes<br>(Lowland) Riparian Landscapes |
| **Pampas Grass** | ***Cortaderia spp.*** | No | B (Forest, Urban)<br>C (Coastal, Riparian) | Coastal, Forest, Riparian, Urban | - | - |
| Cotoneaster | *Cotoneaster* | No | Not prioritised (Urban) | Urban | C | (Lowland) Urban Landscapes |
| Rubbervine | *Cryptostegia grandiflora* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| Cuphea | *Cuphea carthagenensis* | No | - | - | Aa | Agricultural Landscapes |
| Scotch Broom | *Cytisus scoparius* | No | A | Forest | - | - |
| Cape Ivy | *Delairea odorata* | Yes | C (Coastal, Riparian)<br>Not prioritised (Forest) | Coastal, Forest, Riparian | Aa | (Lowland) Forest Landscapes |
| Duranta | *Duranta repens* | No | B (Forest)<br>Not prioritised (Urban) | Forest, Urban | - | - |

| Common Name | Scientific Name | Known Occurrences in Macleay Estuary Area | Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) | | Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) | |
|---|---|---|---|---|---|---|
| | | | Priority | Landscape | Priority | Landscape |
| Dense Waterweed | *Egeria densa* | No | - | - | E | Aquatic Landscapes |
| Anchored Water Hyacinth | *Eichhorni azurea* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| Water Hyacinth | *Eichhornia crassipes* | No | B (Urban)<br>C (Riparian) | Riparian, Urban | B | Aquatic Landscapes |
| Elodea | *Elodea canadensis* | No | - | - | Aa | Aquatic Landscapes |
| Cats Heads | *Emex australis* | No | B | Agricultural | - | - |
| Horsetails | *Equisetum spp.* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | Aa | Aquatic Landscapes |
| Cockspur Coral Tree | *Erythrina crista-galli* | No | B (Agricultural, Riparian)<br>C (Urban) | Agricultural, Riparian, Urban | B ((Lowland) Riparian Landscapes)<br>C ((Lowland) Urban Landscapes) | (Lowland) Riparian Landscapes)<br>(Lowland) Urban Landscapes |
| Painted Spurge | *Euphorbia cyathophora* | No | - | - | Aa | Coastal Landscapes |
| Gaura | *Gaura parviflora* | No | Not prioritised | Urban | - | - |
| Honey Locust | *Gleditsia triacanthos* | No | B (Riparian)<br>C (Urban) | Riparian, Urban | B | (Lowland) Riparian Landscapes |
| Glory Lily | *Gloriosa superba* | Yes | B | Coastal, Urban | C | Coastal Landscapes |
| Narrow Leaf Cotton Bush | *Gomphocarpus fruticosus* | Yes | D | Agricultural | - | - |
| Senegal Tea | *Gymnocoronis spilanthoides* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | Aa | Aquatic Landscapes |
| Blue Heliotrope | *Heliotropium amplexicaule* | No | - | - | B | Agricultural Landscapes |

| Common Name | Scientific Name | Known Occurrences in Macleay Estuary Area | Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) | | Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) | |
|---|---|---|---|---|---|---|
| | | | Priority | Landscape | Priority | Landscape |
| Telegraph Weed | *Heterotheca grandiflora* | No | A | Coastal | - | - |
| Norfolk Island Hibiscus | *Hibiscus insularis* | No | B | Coastal | - | - |
| Hawkweed | *Hieracium spp* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| Glush Weed | *Hygrophila costata* | No | - | - | Aa | Aquatic Landscapes |
| East Indian Hygrophila | *Hygrophila polysperma* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | Aa | Aquatic Landscapes |
| Hymenachne | *Hymenachne amplexicaulis* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | Aa | Aquatic Landscapes |
| **Coolatai Grass** | ***Hyparrhenia hirta*** | No | B (Agcicultural)<br>C (Riparian)<br>Not prioritised (Coastal) | Agricultural, Coastal (not prioritised), Riparian | B | Agricultural Landscapes |
| St Johns Wort | *Hypericum perforatum* | Yes | A | Agricultural, Forest | Aa | Agricultural Landscapes |
| Pink Polkadot Plant | *Hypoestes phyllostachya* | No | - | - | C | (Lowland) Urban Landscapes |
| **Moonflower** | ***Ipomoea alba*** | No | D | - | Aa | (Lowland) Riparian Landscapes |
| **Five Leaf Morning Glory** | ***Ipomoea cairica*** | Yes | D (Coastal)<br>Not prioritised (Riparian, Urban) | Coastal, Riparian, Urban | D | Coastal Landscapes<br>(Lowland) Riparian Landscapes |
| **Blue Morning Glory** | ***Ipomoea indica*** | Yes | D | Coastal | E | (Lowland) Riparian Landscapes |
| Golden Rain Tree | *Koelreuteria elegans* | No | C | Urban | - | - |

| Common Name | Scientific Name | Known Occurrences in Macleay Estuary Area | Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) | | Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) | |
|---|---|---|---|---|---|---|
| | | | Priority | Landscape | Priority | Landscape |
| Lagarosiphon | *Lagarosiphon major* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| **Lantana** | ***Lantana camara*** | Yes | D (Agricultural, Coastal, Forest,)<br>Not prioritised (riparian) | Agricultural, Coastal, Forest, Riparian | C (Agricultural Landscapes<br>Coastal Landscapes (Lowland) Riparian Landscapes)<br>D ((Lowland) Forest Landscapes) | Agricultural Landscapes<br>Coastal Landscapes<br>(Lowland) Riparian Landscapes<br>(Lowland) Forest Landscapes |
| Leucaena | *Leucaena leucocephala* | No | - | - | Aa | (Lowland) Riparian Landscapes |
| Broad Leaf Privet | *Ligustrum lucidum* | Yes | B (Forest)<br>Not prioritised (riparian) | Forest, Riparian | D | (Lowland) Forest Landscapes<br>(Lowland) Riparian Landscapes<br>(Lowland) Urban Landscapes |
| Narrow Leaf Privet | *Ligustrum sinense* | Yes | B (Forest)<br>Not prioritised (riparian) | Forest, Riparian | D | (Lowland) Forest Landscapes<br>(Lowland) Riparian Landscapes<br>(Lowland) Urban Landscapes |
| Formosan Lily | *Lilium formosanum* | Yes | C (Coastal)<br>Not prioritised (Forest) | Coastal, Forest | - | - |
| Limnocharis | *Limnocharis flava* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | Aa | Aquatic Landscapes |
| **Japanese Honeysuckle** | ***Lonicera japonica*** | Yes | - | - | Aa | (Lowland) Riparian Landscapes |
| Willow Primrose | *Ludwigia longifolia* | No | A | Riparian | Aa | Aquatic Landscapes |
| Water Primrose | *Ludwigia peruviana* | No | - | - | Aa | Aquatic Landscapes |

| Common Name | Scientific Name | Known Occurrences in Macleay Estuary Area | Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) | | Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) | |
|---|---|---|---|---|---|---|
| | | | Priority | Landscape | Priority | Landscape |
| African Boxthorn | *Lycium ferocissimum* | No | B | Coastal | - | - |
| **Cats Claw Creeper** | ***Macfadyena unguis-cati*** | Yes | A (Coastal, Forest)<br>B (Urban)<br>C (Riparian) | Coastal, Forest, Urban, Riparian | C | (Lowland) Forest Landscapes<br>(Lowland) Riparian Landscapes |
| Siratro | *Macroptilium atropurpureum* | Yes | - | - | C | Coastal Landscapes |
| Molasses Grass | *Melinis minutiflora* | No | - | - | C | Coastal Landscapes |
| Miconia | *Miconia pigra* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| Miconia | *Miconia spp* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| Murraya | *Murraya paniculata* | No | N | Forest, Urban | - | - |
| Parrots Feather | *Myriophyllum aquaticum* | No | - | - | Aa | Aquatic Landscapes |
| Eurasian Water Milfoil | *Myriophyllum spicatum* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | Aa | Aquatic Landscapes |
| **Chilean Needle Grass** | ***Nassella neesiana*** | No | A | Forest, Riparian | Aa | Agricultural Landscapes |
| **Mexican Feather Grass** | ***Nassella tenuissima*** | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| **Serrated Tussock** | ***Nassella trichotoma*** | No | A | Agricultural, Forest | Aa | Agricultural Landscapes |
| Fishbone Fern | *Nephrolepis cordifolia* | Yes | C (Coastal)<br>Not prioritised (Urban) | Coastal, Urban | D | (Lowland) Urban Landscapes |

| Common Name | Scientific Name | Known Occurrences in Macleay Estuary Area | Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) | | Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) | |
|---|---|---|---|---|---|---|
| | | | Priority | Landscape | Priority | Landscape |
| Yellow Water Lily | *Nymphaea mexicana* | No | - | - | D | Aquatic Landscapes |
| Mickey Mouse Plant | *Ochna serrulata* | Yes | Not prioritised | Coastal, Urban | B | Coastal Landscapes<br>(Lowland) Urban Landscapes |
| African Olive | *Olea europaea spp cuspidata* | No | A | Forest | - | - |
| Prickly Pear Species | *Opuntia stricta, O. vulgaris, O. tomentose, O. aurantiaca* | No | B (Agricultural)<br>C (Coastal, Riparian) | Coastal, Riparian | - | - |
| Broomsrapes | *Orobanche spp.* (except native species *O.cernua var ustraliana* and *O. minor*) | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| Parthenium Weeds | *Parthenium hysterophorus* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| Giant Paspalum | *Paspalum urvillei* | Yes | - | - | E | Coastal Landscapes |
| Broad Leaf Paspalum | *Paspalum wettsteinii* | Yes | - | - | B | Coastal Landscapes |
| - | ***Passiflora spp.*** | Yes | Not prioritised | Coastal, Urban | - | - |
| African Feather Grass | *Pennisetum macrourum* | No | Not prioritised (Urban) | Urban | - | - |
| Lippia | *Phyla nodiflora* | No | A | Urban | Aa | Agricultural Landscapes |
| Rhizomatous Bamboo | *Phyllostachys spp.* | No | B (Riparian)<br>C (Urban) | Riparian, Urban | - | - |
| Slash Pine | *Pinus elliotti* | Yes | - | - | D | (Lowland) Forest Landscapes |

| Common Name | Scientific Name | Known Occurrences in Macleay Estuary Area | Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) | | Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) | |
|---|---|---|---|---|---|---|
| | | | Priority | Landscape | Priority | Landscape |
| Radiata Pine | *Pinus radiata* | No | - | - | D | (Lowland) Forest Landscapes<br>(Lowland) Urban Landscapes |
| Water Lettuce | *Pistia stratiotes* | No | A (Agricultural, Coastal, Forest, Riparian)<br>B (Urban) | Agricultural, Coastal, Forest, Urban, Riparian | Aa | Aquatic Landscapes |
| Cherry Guava | *Psidium cattleianum var. cattleianum* | No | - | - | C | Coastal Landscapes |
| Polygala | *Polygala myrtifolia* | No | - | Coastal | - | - |
| Bracken Fern | *Pteridium esculentum* | Yes | D | Agricultural | - | - |
| - | *Pterospermum rhombifolium* | No | Not prioritised | Coastal | - | - |
| **Kudzu** | ***Pueraria lobata*** | No | - | - | C | (Lowland) Forest Landscapes<br>(Lowland) Riparian Landscapes |
| Firethorn | *Pyracantha sp* | No | Not prioritised | Urban | - | - |
| China Doll | *Radermachera sinica)* | No | Not prioritised | Urban | - | - |
| Indian Hawthorn | *Rhapiolepis indica* | No | B (Coastal)<br>Not prioritised (Urban) | Coastal, Urban | - | - |
| Castor oil | *Ricinis communis* | Yes | Not prioritised | Riparian | E | (Lowland) Riparian Landscapes |
| Coral Berry | *Rivina humilis* | No | - | - | Aa | (Lowland) Riparian Landscapes |
| Black Locust | *Robinia pseudoacacia* | No | C | Urban | Aa | (Lowland) Riparian Landscapes |
| Sweet Briar | *Rosa rubiginosa* | No | - | - | Aa | Agricultural Landscapes |
| Blackberry | *Rubus fruticosus* agg. Spp | Yes | C (Agricultural, Forest)<br>Not prioritised (Riparian) | Agricultural, Forest, Riparian | B | Agricultural Landscapes |

| Common Name | Scientific Name | Known Occurrences in Macleay Estuary Area | Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) | | Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) | |
|---|---|---|---|---|---|---|
| | | | Priority | Landscape | Priority | Landscape |
| Sagittaria | *Sagittaria platyphylla* | No | - | - | Aa | Aquatic Landscapes |
| Willows | *Salix spp.* | Yes | B (Riparian)<br>C (Urban) | Riparian, Urban | C | (Lowland) Riparian Landscapes |
| Salvinia | *Salvinia molesta* | No | B | Urban | B | Aquatic Landscapes |
| Umbrella Tree | *Schefflera actinophylla* | Yes | B | Coastal | C | Coastal Landscapes<br>(Lowland) Forest Landscapes<br>(Lowland) Urban Landscapes |
| Broad Leaf Pepper | *Schinus terebinthifolius* | No | B | Coastal Riparian, Urban | Aa | Coastal Landscapes<br>(Lowland) Riparian Landscapes<br>(Lowland) Urban Landscapes |
| Fireweed | *Senecio madagascarensis* | Yes | C (Coastal)<br>D (Agricultural) | Agricultural, Coastal | E | Agricultural Landscapes |
| Winter Senna | *Senna pendula var. glabrata* | Yes | D (Coastal)<br>Not prioritised (Riparian) | Coastal, Riparian | C | Coastal Landscapes |
| Wild Tabacco | *Solanum mauritianum* | Yes | D (Agricultural)<br>Not prioritised (Coastal, Riparian) | Agricultural, Coastal, Riparian | - | - |
| **Climbing Nightshade** | ***Solanum seaforthianum*** | Yes | - | - | E | (Lowland) Forest Landscapes |
| Canada Golden Rod | *Solidago canadensis* | No | Not prioritised (Urban) | Urban | - | - |
| Johnson Grass | *Sorghum halepense* | Yes | D (Agricultural)<br>Not prioritised (Riparian) | Agricultural, Riparian | C | Agricultural Landscapes |

| Common Name | Scientific Name | Known Occurrences in Macleay Estuary Area | Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) | | Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) | |
|---|---|---|---|---|---|---|
| | | | Priority | Landscape | Priority | Landscape |
| African Tulip Tree | *Spathodea campanulata* | No | C | Urban | - | - |
| Singapore Daisy | *Sphagneticola trilobata* | No | A | Coastal | D | Coastal Landscapes<br>(Lowland) Urban Landscapes |
| **Giant Parramatta Grass** | ***Sporobolus fertilis*** | Yes | C<br>Not prioritised (Coastal) | Agricultural, Coastal, Forest | C | Agricultural Landscapes |
| **Giant Rats Tail Grass** | ***Sporobolus pyramidalis*** | Yes | C<br>Not prioritised (Coastal) | Agricultural, Coastal | B | Agricultural Landscapes |
| Water Soldier | *Stratiotes aloides* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | Aa | Aquatic Landscapes |
| Witchweed | *Striga spp* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | - | - |
| Cocos Palm | *Syagrus romanzoffiana* | No | Not prioritised | Urban | E | (Lowland) Urban Landscapes |
| Golden Trumpet Tree | *Tabebuia chrysotricha* | No | - | - | Aa | (Lowland) Urban Landscapes |
| Athel Pine | *Tamarix aphylla* | No | A | Riparian | - | - |
| Yellow Bells | *Tecoma stans* | No | C | Urban | C | (Lowland) Urban Landscapes |
| Cape honeysuckle | *Tecomaria capensis* | No | Not prioritised | Coastal | - | - |
| Rhus Tree | *Toxicondendron succedaneum* | No | B | Urban | - | - |
| **Trad/Striped Trad** | ***Tradescantia fluminensis*** | Yes | Not prioritised | Riparian | E | (Lowland) Forest Landscapes<br>(Lowland) Riparian Landscapes |

| Common Name | Scientific Name | Known Occurrences in Macleay Estuary Area | Regional Weeds Strategy – 2008 – 2012 (MNCWAC undated) | | Northern Rivers Invasive Plants Action Strategy 2009-2013 (Oakwood 2009) | |
|---|---|---|---|---|---|---|
| | | | Priority | Landscape | Priority | Landscape |
| Water Caltrop | *Trapa spp.* | No | A | Agricultural, Coastal, Forest, Urban, Riparian | Aa | Aquatic Landscapes |
| Chinese Tallow | *Triadica sebifera* | No | A (Riparian)<br>C (Urban) | Riparian, Urban | D | (Lowland) Urban Landscapes |
| Bulbil Watsonia | *Watsonia meriana* | No | | | E | (Lowland) Forest Landscapes |
| Noogoora Burr | *Xanthium occidentale* | No | C (Agricultural)<br>Not prioritised (Riparian) | Agricultural, Riparian | - | - |
| Bathurst Burr | *Xanthium spinosum* | No | C (Agricultural)<br>Not prioritised (Riparian) | Agricultural, Riparian | - | - |
| Arum Lily | *Zantedeschia aethiopica* | No | Not prioritised (Urban) | Urban | - | - |

**Bold** denotes species whose invasion is listed as Key Threatening Process under the Threatened Species Conservation Act.

*Regional Weeds Strategy -2008 – 2012* (MNCWAC undated) priority categories:

- **Category A** - Weeds not currently in the MNCWAC area;
- **Category B** - Weeds present with limited distribution, several small infestations in the MNCWAC area;
- **Category C** - Weeds present with moderate distribution in the MNCWAC area, numberous to large partially dispersed infestations; and
- **Category D** - Weeds that are widespread throughout the region.

*Northern Rivers Invasive Plants Action Strategy 2009-2013* (Oakwood 2009) species prioritisation was based on noxious weeds class of a species and/or a scoring system based on species impact, invasiveness, distribution, rate of spread and whether the species could, within 5 years, feasibly be eradicated (Oakwood 2009). The priority ranks are illustrated in **Table B.2** below.

**Table B.2 Oakwood (2009) Weed Prioritisation Categories**

| *Priority (Rank)* | *Weed Species included* |
|---|---|
| A | Noxious Weeds Class 1 and 2.<br>Weed Species on the National Alert List.<br>Weed species that scored 90+ in the prioritisation process. |
| Aa | Weeds currently absent in that Local Government Area. Includes noxious and environmental weeds. |
| B | Noxious Weeds Class 3.<br>Weed species that scored 80-89 (often only limited distribution).<br>These weed species are predominantly both highly invasive an have substantial impact. |
| C | Weed species that scored 70-79. |
| D | Weed species that scored 60-69. |
| E | Weed species that scored 50-59. |
| F | Weed species that scored less than 40. |

ID Landscape Management (2005) considered the other following other species as locally recorded significant weeds in the Macleay Estuary study area, and ranked them as follows:

- **Category 1** – Most Serious Environmental Weeds (highly invasive and difficult to control): Spike Rush (*Juncus acutus*).
- **Category 2** – Troublesome Environmental Weeds (highly invasive and moderate degree of difficulty in control): Mulberry Tree (*Morus sp.*).
- **Category 3** – Problematic Environmental Weed – invasive and moderate degree of difficulty in control: Bamboo (*Bambussa sp.*), Banana, Umbrella Sedge (*Cypress involucratus*), Gleditsea (*Gleditsea sp.*), Jacaranda (*Jacaranda mimosifolia*) and Poplar (*Populus sp.*).

# Appendix C

## Flora Species Suitable For Riparian Revegetation Projects

**Table 3:** Species suitable for riparian revegetation projects for each Vegetation Zone

| Vegetation Zone | Mid to high tide mark *Toe of bank* | High tide to upper bank *Mid Bank* | Top of bank *Upper bank* |
|---|---|---|---|
| A | **TREES & SHRUBS** | **TREES & SHRUBS** | **TREES & SHRUBS** |
| | *Aegiceras corniculatum* | *Acacia sophorae* | Species listed for Mid bank plus: |
| | *Avicenna marina* | *Banksia integrifolia* | *Acmena smithi* |
| | *Casuarina glauca* | *Callistemon salignus* | *Alphitonia excelsa* |
| | | *Cupaniopsis anacardioides* | *Aphananthe philippinensis* |
| | | *Elaeocarpos obovatus* | *Commersonia fraseri* |
| | | *Glochidion ferdinandi* | *Ficus superba* |
| | | *Guoia semiglauca* | *Ficus rubiginosa* |
| | | *Melaleuca bracteata* | *Jagera pseudorhus* |
| | | *Melaleuca quinquenervia* | *Podocarpos elatus* |
| | | *Melia azedarach* | |
| | | *Myoporum acuminatum* | |
| | | *Pittosporum undulatum* | |
| | | *Rhagodia candolleana* | |
| | | *Syzygium australe* | |
| | | *Syzygium leuhmanni* | |
| | **TUSSOCKS & RUSHES** | **TUSSOCKS & RUSHES** | **TUSSOCKS & RUSHES** |
| | *Crinum pedunculatum* | *Crinum pedunculatum* | *Dianella caerula* |
| | *Juncus usitatus* | *Dianella caerula* | *Lomandra longifolia* |
| | *Phragmites australis* | *Lomandra longifolia* | |
| | | *Tetragonia implexicoma* | |

| B | **TREES & SHRUBS** | **TREES & SHRUBS** | **TREES & SHRUBS** |
|---|---|---|---|
| ***TRANSITION ZONE*** | *Aegiceras corniculatum* | *Acmena smithii* | Species listed for Mid bank plus: |
| | *Avicenna marina* | *Backhousia myrtifolia* | *Acacia irrorata* |
| | *Callistemon viminalis* | *Callistemon salignus* | *Acacia longifolia* |
| | *Casuarina glauca* | *Casuarina cunninghamiana* | *Acacia melanoxylon* |
| | | *Cupaniopsis anacardioides* | *Alphitonia excelsa* |
| | | *Elaeocarpos obovatus* | *Aphananthe philippinensis* |
| | | *Ficus coronata* | *Commersonia fraseri* |
| | | *Glochidion ferdinandi* | *Jagera pseudorhus* |
| | | *Guoia semiglauca* | *Ficus rubiginosa* |
| | | *Melaleuca bracteata* | *Ficus superba* |
| | | *Melia azedarach* | *Ficus rubiginosa* |
| | | *Myoporum acuminatum* | *Ficus superba* |
| | | *Pittosporum undulatum* | |
| | | *Syzygium australe* | |
| | **TUSSOCKS & RUSHES** | **TUSSOCKS & RUSHES** | **TUSSOCKS & RUSHES** |
| | *Bolboschoenus sp.* | *Crinum pedunculatum* | *Dianella caerula* |
| | *Crinum pedunculatum* | *Dianella caerula* | *Lomandra longifolia* |
| | *Juncus usitatus* | *Lomandra hystrix* | |
| | *Phragmites australis* | *Lomandra longifolia* | |
| | *Typha sp.* | *Tetragonia implexicoma* | |

| C | **TREES & SHRUBS** | **TREES & SHRUBS** | **TREES & SHRUBS** |
|---|---|---|---|
| | *Backhousia myrtifolia* | *Acmena smithii* | Species listed for Mid bank plus: |
| | *Callistemon viminalis* | *Alphitonia excelsa* | *Ficus superba* |
| | *Casuarina cunninghamiana* | *Aphananthe philipinensis* | *Ficus rubiginosa* |
| | *Lept. brachyandrum* | *Backhousia myrtifolia* | *Acacia melanoxylon* |
| | *Tristaniopsis laurina* | *Callistemon salignus* | *Commersonia fraseri* |
| | | *Cas. cunninghamiana* | |
| | **TUSSOCKS & RUSHES** | *Elaeocarpos obovatus* | |
| | *Juncus usitatus* | *Glochidion ferdinandi* | **TUSSOCKS & RUSHES** |
| | *Lomandra hystrix* | *Guoia semiglauca* | *Dianella caerula* |
| | *Potamophila parviflora* | *Lept. brachyandrum* | *Lomandra hystrix* |
| | | *Melaleuca bracteata* | *Lomandra longifolia* |
| | | *Melia azedarach* | |
| | | *Tristaniopsis laurina* | |
| | | **TUSSOCKS & RUSHES** | |
| | | *Dianella caerula* | |
| | | *Lomandra hystrix* | |
| | | *Lomandra longifolia* | |

# Appendix D

## Planning Framework

# D.1 The NSW Estuary Management Planning Process

The development and implementation of Estuary Management Plans is overseen by Estuary Management Committees established by Kempsey Shire Council. An estuary management plan is developed through the NSW Estuary Management Policy 1992 and NSW Coastal Policy 1997. A range of NSW legislation and policies are also relevant and will be discussed later is this section.

### D1.1 NSW Estuary Management Policy 1992

NSW Estuary Management Policy is a State Government initiative was aimed at managing the increasing pressures on the estuarine systems. The introduction of this policy meant that the then Department of Natural Resources (now Department of Environment, Climate Change and Water) in consultation with local Councils was responsible for the preparation of Estuary Management Plans. The aim for this Policy was to ensure estuaries were ecologically sustainable while promoting the use of estuaries for social and economic gain.

In conjunction with the Policy the Department also released a manual whereby the following eight stages were identified for the implementation of an Estuary Management Plan.

1. **Establish an estuary management committee**
2. **Assemble existing data, Identify issues and set goals**
3. **Undertake an estuary process study**
   - biological system
   - physical system
4. **Carry out an estuary management study** ***< This report is here***
   - current uses
   - conflicts of use
   - management strategies and objectives
   - management strategies and potential impacts
5. **Prepare a draft estuary management plan**
   - outline goals and values
   - describe how area is to be managed
   - recommended management strategies
   - schedule and cost of activities
6. **Review draft estuary management plan**
   - public
   - stakeholder groups
   - council
   - government
7. **Adopt the estuary management plan**
   - interim measures
   - planning actions
   - restoration works and monitoring
   - education
8. **Monitor and review**

The Macleay Estuary Management Plan has been prepared to specifically fulfil the aims and objectives of the Estuary Management Policy in respect to the Macleay River. The Macleay Management Plan has been prepared in accordance with the Estuary Management Manual, which supports implementation of the Policy.

### D1.2 NSW Coastal Policy 1997

The NSW Coastal Policy deals with population and economic growth whilst protecting the natural, cultural, heritage and spiritual values of the coastal environment. The policy has a strong focus on the principles of Ecologically Sustainable Development (ESD) and incorporates its four principles:

- The precautionary principle;
- Inter-generational equity;
- Conservation of biological diversity and ecological integrity; and
- Improved valuation, pricing and incentive mechanisms.

Through the principles of ESD and the principle of Integrated Coastal Zone Management (ICZM) the 1997 Coastal Policy has set out the following nine goals:

- Protecting, rehabilitating and improving the natural environment of the coastal zone.
- Recognising and accommodating the natural processes of the coastal zone.
- Protecting and enhancing the aesthetic qualities of the coastal zone.
- Protecting and conserving the cultural heritage of the coastal zone.
- Providing for ecologically sustainable development and use of resources.
- Providing for ecologically sustainable human settlement in the coastal zone.
- Providing for appropriate public access and use.
- Providing information to enable effective management of the coastal zone.
- Providing for integrated planning and management of the coastal zone.

The Coastal Policy 1997 understands that the management of coastal zones is the responsibility of State and Local Government as well as the community. ICZM is linked to the framework through the primary goal to maintain, restore or improve the quality of coastal zone ecosystem and the societies they support. The ICZM is unique in that it addresses both the development and conservation challenges for specific coastal areas of Australia.

The Macleay River and its foreshores fall within the defined coastal zone, therefore the coastal policy needs to be considered in the preparation of the Macleay Estuary Management Plan. Councils are required to implement the policy when making local environmental plans applying to land within the coastal zone and to take the provisions of the policy into consideration when determining development applications in the coastal zone.

## D.2 Legislative and Policy Framworks for Estuary Management in NSW

### D2.1 Coastal Protection Act 1979

The NSW Coastal Protection Act 1979 aims to protect, enhance, maintain and restore the environment with concern for both the natural and built environments.

The Coastal Protection Act 1979 has a strong link with the principles of ESD in that the final determination by the Minister for Planning may be rejected if the proposal is not consistent with the ESD principles. The Act also recognises the importance of the social and economic benefits which are a result of sustainable coastal environments.

The Macleay River is subject to the Coastal Protection Act as the coastal zone of protection includes the land one kilometre landward of coastal waters, estuaries, lakes and tidal limits of rivers; therefore having implications for the Macleay River.

### D2.2 Environmental Planning and Assessment Act 1979

A primary objective of the Environmental Planning and Assessment Act (EP&A Act) 1979, primary objective is the proper management, development and conservation of natural and artificial resources for the promotion of economic and social welfare and a better environment. The EP&A Act enables the creation of Local Environmental Plans and State Environmental Planning Policies which deal with land, development and resource management the local, regional and state level.

The relevant plans created under the EP&A Act that are applicable to the Macleay River include the Kempsey Local Environmental Plan 1987 (discussed later), North Coast Regional Environmental Plan (discussed later) and the following State Environmental Planning Policies.

**SEPP 14 – Coastal Wetlands**

The objective of SEPP 14 is to ensure that coastal wetlands are preserved and protected in the environmental and economic interests of the State. SEPP 14 policy prohibits land clearing, levee construction, drainage work and filling without the written consent of the consent authority. Development Applications lodged for such developments also need to be forwarded to the Director of the Parks and Wildlife Group for assessment of the environmental effects.

There are a number of SEPP14 coastal wetlands identified within the study area. Protection and management of these wetlands is undertaken in the EMP which is consistent with the aims and objectives of SEPP14.

**SEPP 26 – Littoral Rainforest**

SEPP 26 aims to provide consideration for development applications are likely to damage or destroy littoral rainforest with a view towards preserving their natural state. Council consent is required for any land directly affected by or within 100m of littoral rainforest.
The SEPP requires that any person shall not erect a building, carry out work, use land for any purpose, or subdivide it, disturb, change or alter any landform or disturb, remove, damage or destroy any native flora or other element of the landscape or dispose of or dump any liquid, gaseous or solid matter, without the consent of Council.

The SEPP is relevant to the management strategies outlines in the plan and therefore all potential works should be designed to be consistent with the SEPP and consent should be sort where appropriate.

**SEPP44 – Koala Habitat Protection**

State Environmental Planning Policy 44 – Koala Habitat aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of population decline.

SEPP44 requires that consent authorities must not issue a development approval without prior investigation of potential and core koala habitat. As there is no Koala Plan of Management for the area, the SEPP applies to the whole Macleay Estuary except for land dedicated or reserved under the National Parks and Wildlife Act 1974 or to land dedicated under the Forestry Act 1916 as a State forest or flora reserve.

Council is however preparing a Koala Plan of Management. The Koala plan of management must be consistent with the estuary management plan and vice versa.

**SEPP 62 – Sustainable Aquaculture**

SEPP 62 encourages the sustainable expansion of the aquaculture industry in NSW. The policy implements the regional strategies already developed by creating a simple approach to identity and categorise aquaculture development on the basis of its potential environmental impact. The SEPP also identifies aquaculture development as a designated development only where there are potential environmental risks and allows oyster aquaculture without development consent within any area designated a Priority Oyster Aquaculture Area (POAA). Importantly, with respect to the Macleay River, it allows the consent authority the ability to refuse a development application if it is satisfied that the development will adversely affect oyster aquaculture or a POAA

**SEPP 71 – Coastal Protection**
SEPP 71 aims to protect and manage the natural, cultural, recreational and economic attributes of the NSW coast through the use of the Ecologically Sustainable Development principles. More specifically this is achieved through the protection and preservation of public access, aboriginal heritage, visual amenity, beach environments, native coastal vegetation, marine environments, rock platforms and management of coastal zones.

All development applications for lands located within sensitive coastal locations are required to be referred to the Director General of Planning for comment.

A Sensitive Coastal Location is described in the Policy as:

- a coastal Lake (as listed in Schedule 1)
- land within 100m above mean high watermark of the sea, a bay or an estuary
- land within 100m of the waters edge of a coastal lake, a declared Ramsar Wetland, a World
- Heritage property, an aquatic reserve, a marine park, a national park, a nature reserve, or a wetland subject to SEPP14
- residential land within 100m of land identified under SEPP26

The Macleay River is within the NSW Coastal Zone as defined by the Coastal Protection Act 1979. Consequently, SEPP71 is applicable to the Macleay Estuary and has been considered during development of management strategies and during implementation.

**SEPP (Infrastructure) 2007**
SEPP (Infrastructure) 2007 came into force in January 2008 and was an amalgamation of several repealed SEPPs in order to facilitate the effective delivery of infrastructure across the State. The repealed SEPP 35 – Maintenance Dredging of Tidal Waterways in now included as a part of SEPP (Infrastructure).

The SEPP:

- outlines planning processes for considering classes of public infrastructure and particular infrastructure projects;
- exempts some minor public infrastructure from the need for an approval;
- clarifies where new infrastructure can be located and provides for additional permissible uses on government land; and
- requires State agencies constructing infrastructure to consult local councils when a new infrastructure development is likely to affect existing local infrastructure or services.

Section 125 of the SEPP under Waterway or Foreshore Management Activities permits without consent certain development for the purposes of waterway or foreshore management activities carried out by or on behalf of a public authority. These include:

- Construction works;
- Routine maintenance works;

- Emergency works, including work required as a result of flooding, storms or coastal erosion; and
- Environmental management works.

Maintenance dredging may be required in the future along the Macleay River in order to maintain the natural flow and ecological processes therefore SEPP (Infrastructure) is considered relevant.

In addition, the SEPP allows development for the purpose of temporary works associated with drought relief to be carried out by or on behalf of a public authority without consent (subject to certain criteria).

These works and consent requirements (or lack of) are considered relevant and are considered in this EMP.

**North Coast Regional Environmental Plan (Deemed SEPP)**
The North Coast Regional Environmental Plan 1988 aims to protect the natural environment whilst maintaining a development that promotes economic and social benefit. The North Coast Regional Environmental Plan draws from other policies to formulate a regional focus in order to develop policies that deal with regionally specific issues. This planning document guides local environmental plans so as to control development within the region and define future land use and development.

### D2.3 Threatened Species Conservation Act 1995

The Threatened Species Conservation Act 1995 deals with the identification of threatened species, ecological communities and the threatening processes whilst aiming to conserve biodiversity and promote ecologically sustainable development. The Act also aims to minimise the external threats which may upset or disturb the functioning of the threatened or endangered species. A licence is required in order to harm or remove any threatened species or ecological community.

Other aspects addressed in the Act include:

- Critical habitat identification;
- Recovery plans for threatened species, populations and communities;
- Threat abatement plans to manage threatening processes;
- Threatened species priorities action statements;
- Correct licensing; and
- Biodiversity banking.

The Threatened Species Conservation Act 1995 applies to the Macleay River as many threatened species listed under the TSC Act are present in the study area. The Act will assist in implementing strategies to ensure habitat protection and conservation within the Macleay Estuary catchment.

It is noted that the NSW Biobanking Scheme is established under this Act. However, it is considered the Biobanking Scheme will not influence the development of the Macleay EMP other than potentially protecting areas that would otherwise not be protected by application of the biobank site tool.

### D2.4 National Parks and Wildlife Act 1974

The National Parks and Wildlife Act 1974 is responsible for the establishment of the National Parks and Wildlife Service which is now integrated into the Department of Environment, Climate Change and Water. The objectives of the National Parks and Wildlife Act include:

- The conservation of nature;
- The conservation of objects, places or features of cultural value within the landscape;

- Fostering public appreciation understanding and enjoyment of nature and cultural heritage and their conservation; and
- Providing for the management of land reserved under this Act.

According to the NP&W Act it is an offence to harm threatened species; buy, sell or possess threatened species; damage critical habitat; or damage the habitat of a threatened species without the issuing of a Section 120 licence.

If any identified archaeological sites or remains need to be removed or destroyed, prior to commencement of management works, an approval is required from the Department of Environment, Climate Change and later.

The Act also requires a Plan of Management to be prepared for National Parks and this plan provides the framework for park use and management.

The Macleay River EMP will need to be consistent with relevant plans of management if any management strategies involve works in a National Park. National Parks within the Macleay River Estuary Management Study Area include Hat Head National Park and Yarrahappinni Wetlands National Park.

**Hat Head National Park Plan of Management**
The Hat Head National Park Plan of Management outlines general management objectives for National Parks in general and specific objectives for the 7220ha of land protected within Hat Head National Park. The plan revolves around the general themes of conservation of important geological features, conservation of diverse habitats and ecosystems, conservation of threatened biota, conservation of biodiversity in general, protection of cultural heritage and appropriate use of park resources.

Within the plan, emphasis is given to the restoration of modified lands and the minimisation of any unacceptable impacts of public use. Additionally, the plan calls for a reduction in the incidence of fire, weeds and feral animals.

The key part of the National Park that lies within the study area is the Swan Pool or East Kinchela Wetland. Management of the wetland does not form a major part of the plan despite the fact that a number of management strategies are being applied there.

**Yarrahappinni Wetlands National Park Plan of Management**
A plan of management for the area is being prepared. PWG is pursuing the full rehabilitation of the wetlands, with the end goal being to restore the wetlands to a natural state reminiscent of the site prior to the flood mitigation works in the 1970s. The full rehabilitation will be undertaken in a staged approach allowing for adaptive site management whilst ensuring positive environmental outcomes for all stakeholders.

### D2.5 Fisheries Management Act 1994

The Fisheries Management Act 1994 aims to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. The Fisheries Management Act is the primary piece of legislation that protects the aquatic flora and fauna. The aims are achieved by;

- Conserving fish stocks and habitats;
- Conserving threatened species and ecological communities;
- Promoting ecological sustainable development;
- Promoting quality and viable recreational and commercial fishing; and
- Providing social and economic benefits for the wider community of New South Wales.

NSW Fisheries which is a part of the Department Primary Industries is the regulatory body of the Fisheries Management Act. Under the Act removal of or damage to seagrass and mangroves requires a permit to be obtained from NSW Industry and Investment (formerly NSW Fisheries).

The Macleay River has several areas of mangroves. Work proposed in the Macleay EMP that will impact on the mangroves or other threatened species or their habitats requires approval from NSW Industry and Investment.

### D2.6 Protection of the Environment Operations Act 1997

The Protection of the Environment Operations Act 1997, aims to protect, restore and enhance the quality of the environment in New South Wales whilst recognising the need for ecologically sustainable development. The Act provides opportunities for the public to be involved in environmental protection as well as information about pollution. The Act addresses pollution of the air, water and land as well as noise pollution.

An environmental protection licence is required for any form of pollution under the Act. Licences are issued by the Department of Environment, Climate Change and Water.

There are a number of scheduled activities pursuant to the Protection of the Environment Operations Act 1997 within the Macleay EMP including the surrounding waste water treatment facilities at South West Rocks, Kempsey and Armidale. Reference and review of the existing Environmental Protection Licenses for scheduled activities maybe required.

### D2.7 Crown Lands Act 1989

The Crown Lands Act is administered by the Land and Property Management Authority to provide for the administration and management of crown land in the eastern and central division of the State. Crown land shall not be occupied, used, sold, leased, licensed, dedicated or reserved or otherwise dealt with unless the occupation, use, sale, lease, licence, reservation or dedication or other dealing is authorised under this Act.

The Land and Property Management Authority is the custodian of crown land status information and administers crown land held under lease, licence or permit under the Crown Lands Act. The authority also manages vacant crown land, land retained in public ownership for environmental protection purposes and the lands of the crown public roads network. Crown land is allocated for public uses, including schools, hospitals, sports grounds, community recreation and housing development. Crown reserves are managed in partnership with both councils and local community groups. The goal of crown Land management is to optimise environmental, economic and social outcomes for the benefit of the people of NSW.

The main areas of crown lands within the Macleay catchment would include the bed of the Macleay and Belmore Rivers and Kinchela and Clybucca Creeks and associated tributaries. Catchment management activities that impact on crown land must be referred to the Land and Property Management Authority.

### D2.8 Local Government Act 1993

The Local Government Act 1993 provides the legal framework for an effective, efficient, environmentally responsible and open system of local government in NSW. Council's responsibilities are outlined in the Act and include 'to properly manage, develop, protect, restore, enhance and conserve the environment of the area for which it is responsible, in a manner that is consistent with and promotes the principles of ecologically sustainable development'.

According to the provisions of the Act, Councils have numerous functions. Chapter 6 of the Act requires that all land vested in Councils must be classified as either community or operational land. Community land is land which should be kept for use by the general public (e.g. a public park). Councils must prepare plans of management to guide the use and management of community land. Core objectives are defined

in the Act for the management of different types of community land. Plans of management prepared for community land within the study area should be generally consistent with the principles of the Macleay EMP.

### D2.9 Water Management Act 2000

The *Water Management Act, 2000* provides an integrated legislative framework for all water resources in the state including groundwater and estuarine and coastal waters to the three nautical mile limit. The overarching objectives of this Act are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations and, in particular:

(a) to apply the principles of ecologically sustainable development, and
(b) to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality, and
(c) to recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water, including:
  (i) benefits to the environment, and
  (ii) benefits to urban communities, agriculture, fisheries, industry and recreation, and
  (iii) benefits to culture and heritage, and
  (iv) benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water,
(d) to recognise the role of the community, as a partner with government, in resolving issues relating to the management of water sources,
(e) to provide for the orderly, efficient and equitable sharing of water from water sources,
(f) to integrate the management of water sources with the management of other aspects of the environment, including the land, its soil, its native vegetation and its native fauna,
(g) to encourage the sharing of responsibility for the sustainable and efficient use of water between the Government and water users,
(h) to encourage best practice in the management and use of water.

### D2.10 Other Relevant Acts

*D2.10.1 Native Vegetation Act 2003*

Native Vegetation Act 2003 repealed the Native Vegetation Conservation Act 1997 and regulates the clearing of native vegetation on all land in New South Wales, except for land listed under schedule 1 of the Act. The objectives of the Act are to, in accordance with the principles of ecologically sustainable development:

- encourage and promote the management of native vegetation in the social, economic and environmental interests of the State,
- prevent clearing unless it improves or maintains the environmental outcome,
- protect high conservation value native vegetation with regard to water quality, biodiversity, or the prevention of salinity or land degradation,
- improve the condition of existing native vegetation, and
- encourage rehabilitation and revegetation of land with appropriate native vegetation,

The NV Act aims to promote the management of native vegetation as well as prevent broad scale clearing unless it improves or maintains environmental outcomes. The Act states that native vegetation must not be cleared except in accordance with:

- a development consent granted in accordance with this Act, or
- a property vegetation plan.

Land to which this Act does not apply:

- SEPP 14 – coastal wetlands
- SEPP 26 – littoral rainforests
- Land reserved under National Parks and Wildlife Act.

The clearing of native vegetation can only be granted by development consent in accordance with the Act or a property vegetation plan.

Vegetation clearing would not normally be recommended under an Estuary Management Plan. Existing NV Act approaches to vegetation management (such as property vegetation plans) in the MEMP should be adopted to assist in implementation. Approaches to development conservation tradeoffs for landowners under the Act should investigated and discussed with DECCW.

*D2.10.2 Catchment Management Authorities Act 2003*

The Catchment Management Authorities Act 2003 repealed the Catchment Management Act and established 13 Catchment Management Authorities (CMA) across New South Wales. The CMA Act created 13 Catchment Management Authorities in New South Walts. CMAs aimed to create natural resources management by the use of catchment boundaries and are aimed at being an inclusive organisation with participation from local organisations, conservation groups, landholders and uses.

Community participation is a critical part of the Act since it provides a basis for best use of catchment knowledge and expertise as well as the provision of financial incentives for landholders for natural resource management.

The Macleay River and associated catchment falls within the Northern Rivers CMA (NRCMA) therefore the Northern Rivers Catchment Action Plan (NRCAP) is applicable. The CAP:

- Identifies and provides long term direction in addressing the sustainable management of our natural resources.
- Establishes repair and rehabilitation work, with Government funds within the catchment.
- Directs incentive projects to maximise the environmental outcomes.

There are several themes within the NRCAP that are appropriate for the Macleay River catchment

- Community; increase the contribution of the community towards natural resource management (NRM).
- Land use planning; natural resources and Aboriginal cultural landscapes are sustainably managed with regard to urban development as well as incorporated into local and regional planning frameworks.
- Biodiversity; the condition of native and aquatic ecosystems are improved.
- Water; improvements are made towards river and aquifer conditions.
- Coastal Management; natural resources within the Coastal Zone are improved
- Marine; the health of the marine environment is improved.
- Soil/Land Resource; improve soil condition so as to support agricultural production and natural ecosystem functions in a sustainable manner.

The Macleay EMP shall be prepared to be consistent with the NRCAP objectives.

*D2.10.3 Heritage Act 1977*

The Heritage Act 1977 protects heritage items, sites, and relics and is administered by the NSW Department of Planning. A relic is defined as any item relating to European settlement that is older than

50 years. According to Section 139 an excavation permit must be obtained from the NSW Heritage Office for the excavation or disturbance of a relic.

There are currently six structures within Kempsey LGA listed under the NSW Heritage Act 1977, and an additional 10 listings by local and state government agencies. The North East Rainforest World Heritage Area along the Great Escarpment in the upper Macleay is also listed under the NSW Heritage Act and is on the works heritage list. The draft Kempsey Shire Community-based Heritage Study recommends additional heritage listings.

HEMP management strategies must ensure they do not detrimentally impact on heritage and proposed items listed under this Act.

*D2.10.4 Noxious Weeds Act 1993*

The Noxious Weeds Act 1993 identifies noxious weeds and specific control measures and duties of public and private landholders. The Act provides a framework for the state wide control of noxious weeds bt the Minister and local control authorities.

The Macleay EMP can support the management of weeds through incorporating the management strategies contained within the Act for the categories of noxious weeds listed.

*D2.10.5 Protection of the Environment Administration Act 1991*

The Protection of the Environment Administration Act 1991 establishes the Environmental Protection Authority (now known as the Department of Environment, Climate Change and Water). One of DECCWs objectives is to report on the state of the environment.

The primary objective of DECCW is to protect, restore and enhance the quality of the environment but also to integrate economic considerations into decision making. DECCW represents the Crown and the affairs of DECCW are managed by the Director-General of the Department of the Environment, Climate Change and Water.

The objectives of the POEA Act must be taken into consideration in preparing the Macleay EMP.

*D2.10.6 Natural Resources Commission Act 2003*

The Natural Resource Commission Act 2003 established the independent body the Natural Resource Commission to deal with the investigation and reporting of the use and management of natural resources in NSW. The Commission has the following objectives as established in the Act:

- establish a sound scientific basis for the properly informed management of natural resources in the social, economic and environmental interests of the State; and
- enable the adoption of State-wide standards and targets for natural resource management issues; and
- advise on the circumstances in which broadscale clearing is to be regarded as improving or maintaining environmental outcomes for the purposes of the Native Vegetation Act 2003.

The commission established the Standard for Quality Natural Resource Management which provides a standard for quality assurance in NSW. Thirteen state wide targets for NRM where adopted in the State Plan which will provide guidance and reference for the Macleay EMP.

The commission also investigates natural resources management with regard to social, economic and environmental interests in order to standardise targets for natural resource management issues. In addition, the Minister for Planning is required to consult with the commission certain development in the coastal area.

*D2.10.7 Environment Protection and Biodiversity Conservation Act (Commonwealth) 1999*

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) provides a legal framework in which nationally and internationally important flora, fauna, ecological communities and heritage sites are managed and protected. It is this framework which forms the basis of the federal government's environmental legislation. The EPBC Act applies to the following seven matters of national environmental significance;

1. World heritage sites;
2. National heritage places;
3. Wetlands of international importance;
4. Nationally threatened species and communities;
5. Migratory species;
6. Commonwealth marine areas; and
7. Nuclear actions.

Management outcomes from the Macleay EMP shall be designed and implemented to ensure consistency with the Commonwealth responsibilities under the Act, most notably in relation to wetlands, nationally threatened species and migratory species.

# D.3 Kempsey Shire Council Planning Framework

### D.3.1 Kempsey Local Environmental Plan 1987

The entire Macleay River estuary and approximately 25% of the total Macleay catchment is within the Kempsey local government area. The upper Macleay catchment falls within four local government areas – Walcha, Armidale Dumeresq, Uralla and Guyra. The Kempsey Local Environmental Plan 1987 describes the Local Government area in regard to zoning and what development is permissible within each zone.

Almost 90% of the catchment is zoned Rural with the balance zoned Forestry, 1(a3) Agricultural Protection. Other zonings include National Parks and Reserves 8(a) which covers approximately 7% of the catchment, and Protection (7) covering approximately 4%. Urban areas (including residential, business and industrial zones) and special use areas occupy less than 1% of the catchment [1].

Kempsey Shire Council has prepared a draft LEP consistent with the Standard Instrument – Principal Local Environmental Plan (SLEP). The draft LEP is currently being reviewed by NSW Department of Planning and is due for public exhibition in early 2011. The new LEP will be gazetted by June 2011.

According to the SLEP, there are three waterway zones that may be applicable to waterways:

| | |
|---|---|
| Zone W1 | Natural Waterways |
| Zone W2 | Recreational Waterways |
| Zone W3 | Working Waterways |

[1] Macleay River Estuary Process Study, WMA 2009 (p18)

Applying the most appropriate zoning will need to consider the tenure, anticipated usage and any land use protective or management measures.

### D.3.2 Kempsey Local Government Development Control Plans

The Kempsey Local Government Development Control Plans (DCPs) establish requirements that are specific to different types of development as well as particular locations. The DCP is used as an addition to the LEP providing more specific development advice and they are created by the Environmental Planning and Assessment Act 1979. There are 37 DCPs which apply to the Kempsey Local Government Area the majority of which do not apply to the Macleay Catchment. At the time of implementationof the estuary management plans, site specific DCPs shouldbe reviewed for consistency. The following general DCPs will need to be considered in preparing the Macleay EMP

- DCP 10 Provision for Open Space for South West Rocks and District;
- DCP 11 Aboriginal Heritage;
- DCP 13 Manufactured Home Estates and Caravan Parks;
- DCP 30 Acid Sulfate Soils; and
- DCP 34 South West Rocks Town Centre.

### D.3.3 Kempsey Shire Ecologically Sustainable Development Strategy

The Kempsey Shire Ecologically Sustainable Development Strategy general objective is 'using, conserving and enhancing the community's resources so that … the total quality of life, now and in the future, can be increased'. The policy aims to implement the four principles of ecologically sustainable development across the social, economic and environmental aspects. The strategy includes not only sustainability but also incorporates trust, co-operation, service, innovation and pride. The strategy has an added benefit in that it was formed with strong community involvement which has been aided by the fact that the strategy is reviewed at regular intervals.

The strategy is relevant to this particular Estuary Management Plan principally that it deals with Total Catchment Management particularly relevant for community consultation, acid sulfate soils and environmental preservation.

### D.3.4 Kempsey Integrated Water Cycle Management Study

The Kempsey Integrated Water Cycle Management integrates water supply, sewerage and stormwater to ensure that the water resource is utilised optimally, now and in the future. Through community consultation and liaison with state government agencies during the preparation of the study, issues and concerns over water cycle management were readily identified. These issues were given a priority rating and management tools and actions were identified to address the issues.

## D.4 Government Policy and the Macleay River

### D.4.1 NSW Government Sea Level Rise Policy Statement

In response to sea level rise the State government has released the NSW Government Sea Level Rise Policy Statement, it sets out the risks to property owners from coastal processes and assistance that Government provides to councils to reduce the risks of coastal hazards. The aim of the Government is to create a smooth transition in the adaptation to sea level rise with disruptions to the social, economic and environmental aspects of society.

The Government intends to support the community and Council by:

- Promoting an adaptive risk-based approach to managing the impacts of sea level rise;

- Providing guidance to local councils to support their sea level rise adaption planning;
- Encouraging appropriate development on the land projected to be at risk from sea level rise;
- Continuing to provide emergency management support to coastal communities during time of floods and storms; and
- Continuing to provide up-to-date information to the public about sea level rise and its impacts.

### D.4.2 NSW State Plan 2006

The primary purpose of the NSW State Plan 2006 is for greater efficiencies and better allocation of Government services for the NSW community. The State Plan focuses on five key areas:

- Rights, Respect and Responsibility;
- Delivering Better Services;
- Fairness and Opportunity;
- Growing Prosperity Across NSW; and
- Environment for Living.

These key areas formulate the goals that have been generated through extensive community consultation and reflect what the community wants the Government to achieve over the next 10 years. Whilst the plan is not all-encompassing it does prioritise the goals by dealing with greatest community concerns first.

The Environment for Living is the area of primary concerned with the Macleay River with particular regard to the following:

- E1 – A secure and sustainable water supply for all users. This priority identified by the Government allows for greater efficiencies in water supply reliability and quality as well as water recycling efficiencies.
- E4 – Better outcomes for native vegetation, biodiversity, land, rivers and coastal waterways. The natural environment is a major player in the economic and social health of communities, tourism on the Macleay River is staple industry for the area.
- E8 – More people using parks, sporting and recreational facilities and participating in the arts and cultural activity. The priority is applicable to this estuary management plan in that it considers actions that may increase the number of State Government park visitors.

### D.4.3 Healthy Rivers Commission – Independent Inquiry into Coastal Lakes 2002

The Healthy Rivers Commission highlighted the lack of understanding about the ecological process at work within coastal lake systems. The lack of understanding has resulted in detrimental consequences to the natural environment as well as the commercial activities these lakes support.
In order to improve the management of coastal lakes and their catchments, the Coastal Lakes Strategy incorporates the following six components:

- principles for managing coastal lakes;
- a framework for managing major classes of coastal lake;
- a classification of coastal lakes;
- requirements for preparing and implementing Sustainability Assessment and Management Plans for each coastal lake;
- implementation arrangements; and
- a range of supporting initiatives.

One of the central features of the strategy is that management needs to address the whole system and not just specific sites. This inclusive view allows for issues and their implications to be identified and dealt with in a manner which would promote the principles of ecologically sustainable development.

There are four classifications for the Coastal Lakes:

- Comprehensive Protection
- Significant Protection
- Healthy Modified Conditions
- Targeted Repair

These classifications allow for specific goals to be created for each lake thereby providing a basis for an achievable management plan. The classification focuses on the natural environment but allows for social and economic considerations thus addressing the principles of Ecologically Sustainable Development .

### D.4.4 NSW Wetlands Management Policy 1996

This document aims to encourage better management of NSW wetlands by halting and, where possible, reversing the loss of wetland vegetation, declining water quality, declining natural productivity, loss of biological diversity and declining natural flood mitigation functions. It also aims to encourage projects and activities that will restore the quality of NSW wetlands, by rehabilitating wetlands, re-establishing buffering vegetation and ensuring adequate water retention.

### D.4.5 Swan Pool Drainage Management Project

The Swan Pool Drainage Management Project was prepared by Wetland Care Australia and funded by the NSW Wetlands Action Group. It delivers a comprehensive plan for the future management of the drainage works surrounding the Swan Pool or East Kinchela Wetland.

The specific features of the plan are:

- Manage flow restrictions by recommissioning the lifting devices on the floodgates, backfilling the backswamp part of the drain and maintaining the intake backswamp by slashing
- Control aquatic vegetation growth in the cut by allowing occasional short term tidal incursion and occasional spot spraying of problem weeds;
- Manage overdrainage, discharge of blackwater and saltwater incursion by backfilling the backswamp part of the drain;
- Raise the invert of the cut to provide a uniform fall from the cut intake to the floodgates;
- Establish a management group made up of landholders, residents and Kempsey LGA representatives

### D.4.6 Macleay Wetlands Management Plan (NCEC 1999)

This document, funded by a Wetland Action Grant under the Natural Resource and Environmental Management Funding Program, described the historical use of and changes to the Macleay floodplain wetlands as well as the collection of biophysical data about the Macleay floodplain wetlands. It also offered some management strategies and recommendations.

### D.4.7 NSW Sustainable Aquaculture Strategy

The NSW Oyster Industry Sustainable Aquaculture Strategy (NSW DPI 2006) outlines the steps necessary for the NSW oyster industry to achieve the sustainable annual production of 120000 bags of oysters by 2013. To achieve this, the strategy identifies areas within NSW estuaries where oyster aquaculture is a priority, documents best practice methods and environmental responsibilities, identifies necessary water quality parameters for oyster aquaculture and describes mechanisms for incorporating water quality requirements into the NSW state planning framework.

### D.4.8 NSW State Rivers and Estuaries Policy 1993

Although published in 1993 and a number of organisational and legislative changes have occurred since that time, the overarching objectives and principles of the policy remain the same today. The overarching objectives of the policy are to manage the rivers and estuaries of NSW in ways which:

- Slow, halt ot reverse the the overall rate of degradation in the systems;
- Ensure the long term sustainability of there essential bio-phsyical functions; and
- Maintain the beneficical use of these resources.

To achieve these objectives, the policy adopts six key principles:

- Those uses of rivers and estuaries which are non-degrading should be encouraged;
- Non-sustainbale resources uses which are not essential should be phased out;
- Environmental degrading processes and practices should be replaced with more efficient and less degrading alternatives;
- Environmentally degraded areas should be rehabilitated and their biophysical functions restored;
- Remnant areas of significant environmental value should be accorded special protection; and
- An ethos for sustainable management of river and estuarine resources should be encouraged in all agencies and individuals who own, manage or use these resources.

### D.4.9 NSW State Coastal Policy 1997

The 1997 NSW Coastal Policy sets the context in providing for population growth and economic development at the same time protecting the natural, cultural, spiritual and heritage values of the coastal environment. To achieve this, the Policy has a strong integrating philosophy based on the principles of ecologically sustainable development (ESD).

The Policy addresses a number of key coastal themes including:

- population growth in terms of physical locations and absolute limits;
- coastal water quality issues, especially in estuaries;
- disturbance of acid sulfate soils;
- establishing an adequate, comprehensive and representative system of reserves;
- better integration of the range of government agencies and community organisations involved in coastal planning and management;
- indigenous and European cultural heritage; and
- integration of the principles of ESD into coastal zone management and decision making.

# Appendix E

## Community and Stakeholder Consultation

# E.1 Consultation Strategy

Community and stakeholder views form an integral component of the NSW estuary planning process. For this study, community and stakeholder views have been sought in a number of ways including:

- initial round of community consultation meetings;
- community survey;
- Monthly updates on Council's website;
- Comment on draft documents;
- Community working groups;
- Media releases; and
- Through the Coast and Estuary Management Committee.

An outline of the strategy steps is provided in **Table D.1**.

**Table E.1 Consultation Strategy Outline**

| *Task* |
|---|
| **Monthly Updates** |
| ▪ monthly progress updates for study uploaded to Council's website |
| **Community Consultation** |
| ▪ media release for initial round of community consultation meetings (fax to local Pos / newsagencies to pin up on Community Noticeboards) |
| ▪ initial round of community consultation meetings |
| ▪ establish of a community working group |
| ▪ distribute outcomes from initial round of community consultation meetings. Distribute to: participants; community working group; CEMC; and posting on Council's website |
| ▪ survey of community and stakeholders using a mail-out survey format to assist with the prioritisation of management issues |
| ▪ distribute summary of survey results. Distribute to: community working group; CEMC; and posting on Council's website (allow 4 weeks for return of survey and 2 weeks to compile) |
| ▪ liaison with community working group to update on progress, gain feedback and clarify information |
| ▪ media release for second round of community consultation meetings; |
| ▪ second round of community consultation meetings / workshops following completion of the draft EMS |
| ▪ distribute outcomes from second round of community consultation meetings / workshops. Distribute to: participants; community working group; CEMC; and posting on Council's website |
| ▪ media release for third round of community consultation meetings; |
| ▪ third round of community consultation meetings / workshops following completion of the preliminary draft EMP |
| ▪ distribute outcomes from third round of community consultation meetings / workshops. Distribute to: participants; community working group; CEMC; and posting on Council's website |
| ▪ media release and public exhibition of the draft EMP |
| **Stakeholder Consultation** |
| ▪ initial contact with key stakeholders: |

| *Task* |
|---|
| - via formal letter; and<br>- via telephone / email;<br>(refer to Stakeholder section for list of organisations) |
| ▪ site meetings with key stakeholders to discuss issues, current actions, opportunities and impediments |
| ▪ survey of community and stakeholders using a mail-out survey format to assist with the prioritisation of management issues |
| ▪ distribute summary of survey results. Distribute to: community working group; CEMC; and posting on Council's website (allow 4 weeks for return of survey and 2 weeks to compile) |
| **Coast and Estuary Management Committee** |
| ▪ attendance at CEMC quarterly meeting near timing of draft EMS to present updates and discuss issues |
| ▪ attendance at CEMC quarterly meetings near timing of draft EMP to present updates and discuss issues |
| **Final Documentation** |
| ▪ production of all draft and final documents in a suitable format for web-access via Council's website |

## E.2 Initial Community Consultation Meetings

A summary of the initial round of open public meetings held at Stuarts Point, South West Rocks and Kempsey in September / October 2009 is shown on the following pages. The purpose of the meetings were to inform the community of the general objectives and scope of the study and to obtain initial input on community values, uses, issues and objectives for the estuary.

The following tables summarise community views in respect to:

- estuary values – aspects of the estuary valued by the community;
- issues of concern regarding the state of the estuary or how it is managed; and
- estuary management objectives – goals or ideas to improve the health of the estuary or improve management of the estuary

**South West Rocks Workshop - CWA Hall, Landsborough Street – Monday, 28th September 2009, 6pm to 8pm**

| Estuary Values | Issues of Concern | Estuary Management Objectives |
|---|---|---|
| ▪ Back Creek is considered a valuable location for its amenity and as a tourist attraction (comment was made that Council have closed Back Creek due to water quality concerns. Stormwater management needs improving between caravan park and Gregory Street)<br>▪ It was indicated that platypus were previously observed near Frederickton Ferry. It is considered desirable to improve health of river to re-establish this type of aquatic life;<br>▪ used to catch Bass in Clybucca Creek but not after 2001;<br>▪ canoe access – there are access points but aren't well known;<br>– could be more access points;<br>– at Belgrave Falls access has been closed after flood due to wash out of ramp;<br>– it was noted that canoe usage is generally low along the length of the river but it should be supported;<br>▪ riparian vegetation: it was commented that bottlebrushes hold shingle banks together and re-establish quickly after floods. | ▪ Riparian Land and Bank Erosion:<br>– rock training walls along the river haven't helped erosion<br>– it was commented that erosion has occurred behind initial rock walls resulting in the decision to thicken walls;<br>– it was commented that bank restoration / rock wall near Dennis Bridge at Port Macquarie appears to work, mangroves get trapped behind;<br>– above Turners Flat – issues with cows accessing banks and causing erosion;<br>▪ Floodgates / Drains Management:<br>– deoxygenated water from drained areas is having a big impact on estuary health;<br>▪ Flooding:<br>– concern that height of levee banks makes flooding worse in large flood events;<br>– also concern that fabridam is worsening flood levels;<br>– impact of Pacific Highway upgrade on flooding; | ▪ Fishing:<br>– 2 bag limit for bass is considered a good thing;<br>– keep cattle out of river to help Bass numbers;<br>– need holes for fish habitat;<br>– need structures to attract prawns / crustaceans;<br>▪ Biological monitors such as bird numbers were suggested as a measure of success for estuary improvements;<br>▪ Riparian Land and Bank Erosion:<br>– it would be good to have some vegetation buffer between farmland and the river to stop nutrients / promote riparian vegetation;<br>– fencing of riverbanks to prevent cattle access to riverbank is considered important;<br>– speed limits for larger boats to limit erosion damage to banks;<br>▪ Floodplain Wetlands:<br>– commented that Peter Andrews 'natural sequence farming' approach (Australian Story) may be worth considering; |

| Estuary Values | Issues of Concern | Estuary Management Objectives |
|---|---|---|
| | ▪ Boating:<br>– banks washed away at end of boat ramps (eg. at Geenhills quarry site);<br>▪ Fishing:<br>– concern commercial fishing has increased in Macleay because its banned elsewhere;<br>– beach fishing – concern that interstate visitors are fishing illegally;<br>▪ Sedimentation and Dredging:<br>– concern that all previous works / spending hasn't improved things;<br>– dredging needed near southern side of Jerseyville for boating navigation and may help reduce flooding impact;<br>– Spencers Creek is silting up;<br>– silting up is increasing flood levels;<br>– issue of opening up Back Creek to main arm;<br>– Frederickton ferry silted up now – used to be able to handle big boats (12 ft draught);<br>▪ Seagrass beds: after 2001 floods a large amount of of seagrass beds 'never came back';<br>▪ all previous works / money hasn't improved the estuary; | – suggested it would be good to lessen the depths of the drainage channels that drain the wetlands and open the floodgates more – get it back to where it was … to more a natural state;<br>▪ Boating:<br>– should be plan to control jet skiers – how fast and where to use<br>– speed limits for larger boats to limit erosion damage to banks;<br>▪ Sedimentation and Dredging:<br>– Suggested there may be potential uses for dredged sediment;<br>▪ Water Quality:<br>– water quality coming into Back Creek needs to be made public and something needs to be done to improve stormwater quality into creek;<br>▪ Climate Change:<br>– incorporate sea level rise into planning documents;<br>▪ Tourism:<br>– 'primitive' camping sites should be considered (eg. near Jew Bite on south side of entrance, near main training wall);<br>– Improving Back Creek for tourism and amenity;<br>▪ sewerage works for saltwater development; |

**Stuarts Point Workshop - Stuarts Point Community Hall 2A Ocean Ave – Wednesday, 30th September 2009, 6pm to 8pm**

| Estuary Values | Issues of Concern | Estuary Management Objectives |
|---|---|---|
| ▪ recreational fishing;<br>▪ direct access to river from Stuarts Point caravan park for fishing;<br>▪ migratory birds –an attraction for tourists e.g. black swans, jabiru;<br>▪ swimming: used to do it a lot but not as much now due to water quality concerns;<br>▪ tourist attraction – eg. Conferences at 7-Day Adventist conference centre is considered good with activity it brings;<br>▪ heritage – non-indigenous heritage associated with Macleay Arm and old river pilot station & signalling:<br>– used to be used as teaching resource;<br>– some interest from people associated with historical society;<br>▪ Golden Hole thought to have indigenous significance where indigenous used to capture fish<br>▪ Indigenous heritage associated with Clybucca midden; and<br>▪ riparian vegetation / ecological value in Macleay Arm is seen as value compared to southern areas. | ▪ Sedimentation in Macleay Arm – prevents houseboats;<br>▪ waves breaching the dunes on large king tides near Fishermans Reach<br>▪ navigate hard at low tide from Stuarts Point to Fishermans Reach:<br>– very shallow and narrow;<br>– very hard to know where to go;<br>▪ concern that boating / navigation issues will impact on tourism in Stuarts Point;<br>▪ fishing – feeling that concentrated commercial fishing in Macleay has depleted fish. It is thought that due to other estuaries restricting commercial fishing there is increased fishing in Macleay Estuary;<br>▪ illegal dumping of excess fish from river bank;<br>▪ camp kitchen noticeboard in Stuarts Point or caravan park;<br>▪ seagrass habitat in north Macleay Arm area being disturbed by commercial netting across the river;<br>▪ leachate from buried material at old Stuarts Point tip – uncertainty in regard to where is the leachate moving to (to the river or water supply)<br>▪ declining water quality making Macleay Arm undesirable for swimming. Concern that there's not enough flushing to improve water quality;<br>▪ weeds along bank near the Stuarts Point caravan | ▪ rotating fishing sanctuary zones in different areas of the estuary (test a no-take zone for a short period & monitor for both recreational and commercial);<br>▪ protection of riparian zone including enforcement<br>▪ like to see riparian edge vegetated more;<br>▪ boardwalks from Stuarts Point to Fishermans Reach with interpretive signage along western edge of river and all the way to middens & Yarrahapinni;<br>▪ no netting or fishing in the seagrass area in north of Macleay Arm;<br>▪ sanctuary zone in north of Macleay Arm;<br>▪ mooring facilities at South West Rocks (near Mattys Flat) to visit from Stuarts Point / Fishermans Reach (like the one at Smithtown near the pub); |

| Estuary Values | Issues of Concern | Estuary Management Objectives |
|---|---|---|
| | park is making it an undesirable place to swim;<br>▪ abandoned oyster beds around Fishermans Reach thought to be dangerous. Should be removed as they are a safety hazard;<br>▪ bank erosion near Andersons Inlet (past Shark Island);<br>▪ decline in crab numbers – reduced catch with pots;<br>▪ stormwater pollution from drain outlets;<br>▪ caravan septic system overflows; | |

**Kempsey Workshop - Anglican Hall, Marsh Street – Thursday, 1st October 2009, 6pm to 8pm**

| Estuary Values | Issues of Concern | Estuary Management Objectives |
|---|---|---|
| ▪ recreational fishing;<br>– Bass;<br>– 80 attend Bass competition;<br>▪ Natural ability of river to recuperate;<br>– 2 years after 2001 best mud crab season in years;<br>▪ 'runout' from Macleay River – food for Trial Bay system;<br>▪ aesthetic viewed from;<br>– bridge;<br>– highway; and<br>– river edge area.<br>▪ social;<br>– boating use;<br>– recreational fishing;<br>– passive recreation;<br>– fishing competitions; and<br>– flow-on to local businesses.<br>▪ fishing attraction – people returning for 20 years;<br>▪ access to ocean fishing in close distance to continental shelf;<br>▪ Stuarts Point – fishing provides small, continual tourist numbers;<br>▪ skeeter boat fishing competition;<br>▪ Bream competition: | ▪ not recognising bank erosion work by landowners;<br>▪ blaming farmers for bank erosion;<br>▪ recovery of habitat / in-stream vegetation after flooding;<br>▪ massive fish kill February 2009<br>– Belmore Gates<br>– Fabri Dam;<br>▪ silting issues for dragon boat and other boating competitions at Kempsey;<br>▪ Kempsey riverside boat ramp – silting / shoaling issue;<br>▪ boat ramp at Greenhills unusable due to drop at ramp;<br>▪ houseboats – shallow water issues at Kempsey;<br>▪ stormwater pollution from Kempsey – CBD and urban areas including;<br>– heavy metals;<br>– sediment;<br>– hydrocarbon; and<br>– litter, butts.<br>▪ water quality – truck wash-down areas going to river at Kempsey (Kempsey has a large truck population). Suggestion of enforcing designated sites<br>– Saleyards site with treatment provides a | ▪ boat access at Kempsey:<br>– deepen the access area at riverside and near island towards railway bridge;<br>▪ better funding for land owners for riverbank protection works. For example:<br>– re-battering banks; and<br>– vegetating banks.<br>▪ improve cleared access (non-boating) to river for general passive recreation:<br>– weed clearing – lantana / coral trees etc.<br>▪ active promotion of river / river activities to increase tourism to area;<br>▪ dredging near Belmore;<br>▪ water quality – suggestion of enforcing designated truck wash-down sites<br>– Saleyards site with treatment provides a 'central' manageable facility); |

| Estuary Values | Issues of Concern | Estuary Management Objectives |
|---|---|---|
| – South West Rocks Fishing Club?; and<br>– Country Club?<br>▪ tourism;<br>▪ Dragon Boat competition;<br>▪ Kempsey riverside boat ramp though to be generally easier / more suitable launching location. (Greenhills better for going upstream); and<br>▪ improvement in wetlands was noted e.g. Yarrahapinni – value of floodgate structure for deterring boating. | 'central' manageable facility);<br>▪ parking areas insufficient at boat ramps … or will be insufficient in future;<br>▪ Belmore River silting up / narrow navigable channel;<br>▪ Belmore Flood Control Structure (Fabri Dam) has been raised – raises upstream flood levels, therefore levees need raising to prevent adjacent flooding (floodplain management issues);<br>▪ litter from recreational fishers (baits, bags etc.);<br>▪ litter from tree planting 'covers';<br>▪ landowners wearing costs for some previous flood mitigation work; and<br>▪ deeper navigable channels were created/maintained by continual dredging. | |

## E.3 Community Survey

A general survey and boating survey were conducted over a two month period from 21 December 2009 to 5 February 2010. The survey period coincided with school summer holidays when visitor numbers and recreational and commercial tourism activity in the region were at a peak.

The survey method involved the following steps:

- Preparation of a detailed questionnaire containing 15 multiple choice and written response questions;
- Placement of survey forms and lodgement boxes at the following venues within the study area:
  - Stuarts Point Supermarket & Liquor Mart;
  - Stuarts Point Holiday Park;
  - SWR Boatshed, Mattys Flat;
  - NSW Maritime Office, South West Rocks;
  - Rocks Marine Bait & Tackle, South West Rocks;
  - Smithtown Post Office and General Store;
  - Gladstone General Store;
  - CJ's Tackle and Sport, Kempsey; and
  - Kempsey Shire Council office, Kempsey.
- Placement of survey notices in local print media and the Kempsey Shire Council website.

A copy of the General Survey form is shown overleaf.

A total of 162 completed forms for the 'General Survey' were received at the conclusion of the survey period. A summary of the full results is shown on the following pages.

KEMPSEY SHIRE COUNCIL

Macleay River Estuary Management Study and Plan

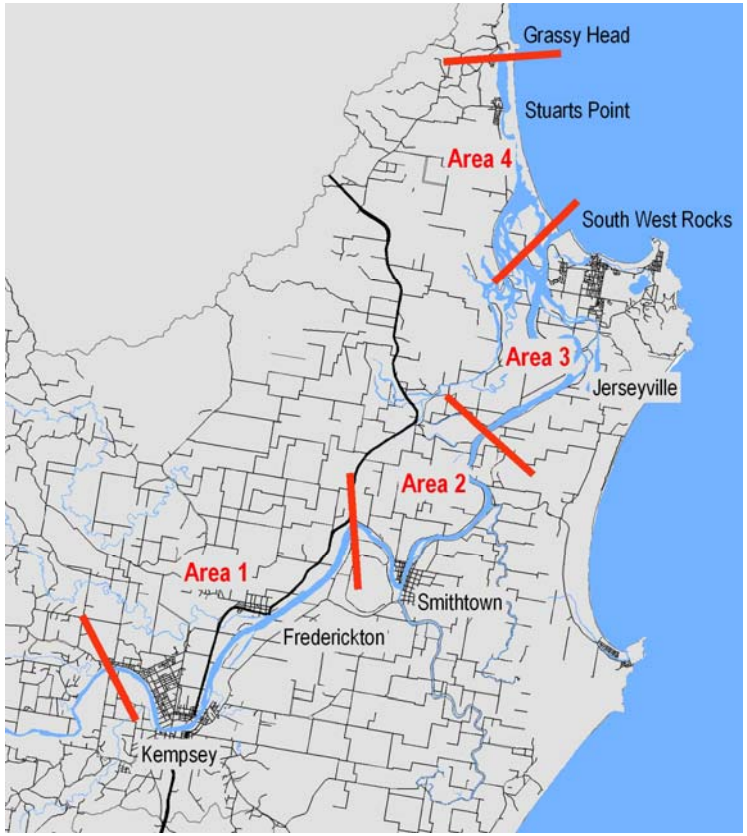
# COMMUNITY SURVEY

Kempsey Shire Council in association with the Department of Environment Climate Change & Water, NSW Maritime and consultants GeoLINK, GECO Environmental, and Aquatic Science & Management is preparing an Estuary Management Study and Plan for the Macleay River.

The study will examine the critical processes, threats and uses of the river including boating, fishing, river and foreshores access, riverbank erosion, protection of floodplain wetlands and water quality issues. A detailed boating assessment is also being undertaken concurrently to improve the general understanding of boating usage patterns and management requirements.

Study outcomes will provide direction for sustainable management of the estuary and possible future capital works including improved boat launching facilities, bank restoration, possible fishing sanctuary zones and protection of significant wetland areas.

Stakeholder and community participation is vital to the success of the Plan.




## Please take this opportunity to participate in the study by completing this survey

You can lodge your completed survey by:

- Hand: In the collection box at a survey venue
- Post: GeoLINK, PO Box 1446 Coffs Harbour NSW 2450
- Facsimile: 02 6651 7733
- Email: Macleay.estuary.study@geolink.net.au

## Survey forms must be received by Friday 5 February 2010

Macleay River Estuary Management Study and Plan

# General Community Survey

1. Are you a resident in one of the following precincts within the Study Area (refer to map)?

| ☐ Macleay Arm Area Grassy Head / Stuarts Point / Fishermans Reach / Clybucca (Area 4) | ☐ Macleay River Entrance Area: South West Rocks / Jerseyville (Area 3) | ☐ Middle Reach Area: Kinchella / Gladstone / Smithtown (Area 2) | ☐ Upper Reach Area: Fredrickton / Kempsey / Greenhill (Area 1) |
|---|---|---|---|

Please provide your postcode: ☐

2. If not, where are you from?

| ☐ Elsewhere within the Kempsey Council Area | ☐ Port Macquarie – Hastings Council Area | ☐ Nambucca Council Area | ☐ Elsewhere on the Mid North Coast | ☐ Other area in NSW | ☐ Interstate / Overseas |
|---|---|---|---|---|---|

Please provide your postcode if you are from Australia: ☐

3. Please indicate how you use the Macleay River estuary area ... (tick one or more boxes)

| ☐ Boating (please also complete the attached Recreation Boating Community Survey) | ☐ Swimming | ☐ Picnicking / Walking | ☐ Farming on the floodplain |
|---|---|---|---|
| ☐ Recreational Fishing | ☐ Commercial Fishing | ☐ Aquaculture | ☐ Other (please describe) …. |

4. Please indicate the importance you place on the following estuary related values…

*Your answers will help focus the future management of the estuary area.*

| | Very Important | Important | Not Important | Don't Know |
|---|---|---|---|---|
| Boating activities within the estuary (please also complete the attached Recreation Boating Community Survey) | ☐ | ☐ | ☐ | ☐ |
| Easy navigation of the river and Macleay Arm by boat (please also complete the attached Recreation Boating Community Survey) | ☐ | ☐ | ☐ | ☐ |
| The ability to fish within the estuary | ☐ | ☐ | ☐ | ☐ |
| Vehicle or pedestrian access to the river for non-boating activities eg. picnicking / walking | ☐ | ☐ | ☐ | ☐ |
| Walking access along the river | ☐ | ☐ | ☐ | ☐ |
| Riverside tourist accommodation | ☐ | ☐ | ☐ | ☐ |
| Attraction to tourists | ☐ | ☐ | ☐ | ☐ |
| Safe swimming locations | ☐ | ☐ | ☐ | ☐ |
| Protecting the riverbanks from erosion | ☐ | ☐ | ☐ | ☐ |
| Native riverside vegetation | ☐ | ☐ | ☐ | ☐ |
| Floodplain backswamps / wetlands | ☐ | ☐ | ☐ | ☐ |
| Good water quality in the river | ☐ | ☐ | ☐ | ☐ |
| Oyster growing | ☐ | ☐ | ☐ | ☐ |
| Historical / cultural values | ☐ | ☐ | ☐ | ☐ |

5. What other features of Macleay River are important to you?

*(Please describe)*

Macleay River Estuary Management Study and Plan

# General Community Survey

6. Are you happy with current access arrangements to the river, its creeks and adjoining banks?

*(Indicate Yes/No & comment)*

| | Yes | No | |
|---|---|---|---|
| Boat ramps | ☐ | ☐ | *Comment:* |
| Vehicle access | ☐ | ☐ | *Comment:* |
| Pedestrian access | ☐ | ☐ | *Comment:* |
| Disabled access | ☐ | ☐ | *Comment:* |

7. How would you rate the health of Macleay River in regard to ...

| | Very Poor | Poor | Moderate | Good | Very Good |
|---|---|---|---|---|---|
| Water quality | ☐ | ☐ | ☐ | ☐ | ☐ |
| Fish populations / aquatic ecosystems | ☐ | ☐ | ☐ | ☐ | ☐ |
| Riverside vegetation | ☐ | ☐ | ☐ | ☐ | ☐ |
| Bank stability | ☐ | ☐ | ☐ | ☐ | ☐ |
| Navigation | ☐ | ☐ | ☐ | ☐ | ☐ |
| Floodplain backswamps | ☐ | ☐ | ☐ | ☐ | ☐ |
| Oyster harvest areas | ☐ | ☐ | ☐ | ☐ | ☐ |

8. What, if any, issues or impacts do you think affect the health of the Macleay River estuary?

*(Please describe)*

9. Would you support the creation of fishing sanctuary zones in some critical locations?

| Strongly Support | Moderately Support | Do Not Support | Don't Know |
|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ |

10. Are any of the following issues of concern to you?

| | Very Concerned | Concerned | Un-concerned | Don't Know |
|---|---|---|---|---|
| Urban / residential development along the river edge | ☐ | ☐ | ☐ | ☐ |
| Commercial / industrial development along the river edge | ☐ | ☐ | ☐ | ☐ |
| Bank erosion | ☐ | ☐ | ☐ | ☐ |
| Lack of riverside vegetation | ☐ | ☐ | ☐ | ☐ |
| Overfishing | ☐ | ☐ | ☐ | ☐ |
| Acid sulfate soils | ☐ | ☐ | ☐ | ☐ |
| Lack of habitat protection | ☐ | ☐ | ☐ | ☐ |
| Degraded floodplain backswamps / wetlands | ☐ | ☐ | ☐ | ☐ |
| Spread of aquatic weeds | ☐ | ☐ | ☐ | ☐ |
| Sea level rise and climate change | ☐ | ☐ | ☐ | ☐ |
| Operation of floodgates and drainage works | ☐ | ☐ | ☐ | ☐ |
| Dredging of the river | ☐ | ☐ | ☐ | ☐ |
| Poor water quality and fish kills after flooding | ☐ | ☐ | ☐ | ☐ |
| Protection of the shellfish industry | ☐ | ☐ | ☐ | ☐ |
| Scenic amenity | ☐ | ☐ | ☐ | ☐ |
| Cultural heritage (indigenous) | ☐ | ☐ | ☐ | ☐ |
| Inadequate treatment of stormwater and effluent | ☐ | ☐ | ☐ | ☐ |
| Other *(please describe)* | ☐ | ☐ | ☐ | ☐ |

11. Are there any other comments you would like to make?

Macleay River Estuary Management Study and Plan

# Recreation Boating Community Survey

1. Are you a resident in one of the following precincts within the Study Area (refer to map)?

| ☐ Macleay Arm Area Grassy Head / Stuarts Point / Fishermans Reach / Clybucca (Area 4) | ☐ Macleay River Entrance Area: South West Rocks / Jerseyville (Area 3) | ☐ Middle Reach Area: Kinchella / Gladstone / Smithtown (Area 2) | ☐ Upper Reach Area: Fredrickton / Kempsey / Greenhill (Area 1) |
|---|---|---|---|

Please provide your postcode: ☐

2. If not, where are you from?

| ☐ Elsewhere within the Kempsey Council Area | ☐ Port Macquarie – Hastings Council Area | ☐ Nambucca Council Area | ☐ Elsewhere on the Mid North Coast | ☐ Other area in NSW | ☐ Interstate / Overseas |
|---|---|---|---|---|---|

Please provide your postcode if you are from Australia: ☐

3. What do you use your vessel for … (tick one or more boxes):

☐ Private / Recreational ☐ Business / charter

4. What is your primary boating activity?

☐ Recreational boating
☐ Charter – Dive
☐ Charter- Fishing
☐ Charter - recreational
☐ Commercial Fishing
☐ Competitive event (please specify)
☐ Recreational Fishing
☐ Paddling
☐ Water skiing
☐ Jet skiing
☐ Accessing other riverside destinations
☐ Other (please specify)

5. What type/size of vessel do you use?

Please indicate size of vessel

| | 0 – 5m | 5 – 8m | 8 – 12m | 12m and over |
|---|---|---|---|---|
| ☐ Cabin runabout | ☐ | ☐ | ☐ | ☐ |
| ☐ Motor Cruiser | ☐ | ☐ | ☐ | ☐ |
| ☐ Canoe/kayak | ☐ | ☐ | ☐ | ☐ |
| ☐ Houseboat | ☐ | ☐ | ☐ | ☐ |
| ☐ Inflatable | ☐ | ☐ | ☐ | ☐ |
| ☐ Open runabout(tinny) | ☐ | ☐ | ☐ | ☐ |
| ☐ Paddle (Row) Boat | ☐ | ☐ | ☐ | ☐ |
| ☐ Personal Watercraft (Jet Ski) | ☐ | ☐ | ☐ | ☐ |
| ☐ Sailing Vessel | ☐ | ☐ | ☐ | ☐ |
| ☐ Other (please specify) | ☐ | ☐ | ☐ | ☐ |

6. Where do generally launch from ?

☐ Grassy Head ☐ Stuarts Point ☐ Fishermans Reach
☐ Mattys Flat ☐ Jerseyville ☐ Other (please describe)….

**7.** Where do you take your boat once it is launched?

| ☐ On the river but remain within the same precinct (up to 5km distance) | ☐ On the river but travel some distance (over 5km) into other precincts | ☐ Onto the ocean |
|---|---|---|

8. How often do you access the river for boating?

☐ Daily ☐ Weekly ☐ Monthly ☐ Yearly ☐ Other (please specify)

Macleay River Estuary Management Study and Plan

# Recreation Boating Community Survey

9. How do you compare the natural aspects of the Macleay River for recreational boating with other coastal river systems?

☐ Much preferred ☐ Similar ☐ Least favoured

10. How do you compare the facilities and boating infrastructure on the Macleay River with other coastal river systems?

☐ Much preferred ☐ Similar ☐ Least favoured

11. What do you think about the existing Navigation Aids?

| | Agree | Disagree | Don't Know |
|---|---|---|---|
| They are of a good standard | ☐ | ☐ | ☐ |
| They adequately assist with general navigation of the river | ☐ | ☐ | ☐ |

12. What do you value about the river in its present state?

| | Very Important | Important | Not Important | Don't Know |
|---|---|---|---|---|
| Natural environment and scenic quality (ie sense of uniqueness, riparian vegetation, open/ enclosed water settings, distant views, native fauna) | ☐ | ☐ | ☐ | ☐ |
| Recreational Opportunities (ie diversity of water based experiences) | ☐ | ☐ | ☐ | ☐ |
| Ability to pursue activities on the river in a fair and equitable manner | ☐ | ☐ | ☐ | ☐ |
| Protection of the river banks | ☐ | ☐ | ☐ | ☐ |
| Adequacy of boating infrastructure | ☐ | ☐ | ☐ | ☐ |
| Safety | ☐ | ☐ | ☐ | ☐ |
| Amenity (proximity to services, ease of access, facilities to support boating activity) | ☐ | ☐ | ☐ | ☐ |

13. What do you believe are the key issues that impact on recreation boating in the river?

| | Very Significant | Significant | Not Significant | Don't Know |
|---|---|---|---|---|
| Inadequate boat storage and key infrastructure (ie ramps, moorings, jetties, pontoons, boat harbour, parking) | ☐ | ☐ | ☐ | ☐ |
| Inadequate supplementary boating facilities (wash down areas, sewerage and rubbish collection, commercial services) | ☐ | ☐ | ☐ | ☐ |
| Availability and quality of visitor facilities (picnic areas, toilets, open space) | ☐ | ☐ | ☐ | ☐ |
| Inadequate launching access to alternative parts of the river (road connections, private property, difficult physical conditions) | ☐ | ☐ | ☐ | ☐ |
| Disused oyster beds impacting on safe navigation | ☐ | ☐ | ☐ | ☐ |
| Difficult navigation of the river due to limited depth in certain locations (please specify below the locations where you experience difficulty) | ☐ | ☐ | ☐ | ☐ |
| Loss of amenity (excessive and / or conflicting uses, poor infrastructure maintenance, irresponsible/antisocial behaviour) | ☐ | ☐ | ☐ | ☐ |
| Environmental protection (damaging uses, loss of biodiversity and habitat, water quality) | ☐ | ☐ | ☐ | ☐ |
| Safety and security (floods, currents, vandals, conflicts between users, emergency response) | ☐ | ☐ | ☐ | ☐ |

Difficult navigation locations due to limited depth:
(please specify eg. between Fishermans Reach and Stuarts Point)

14. What is your vision for creating a more attractive recreational boating environment within the Macleay River? (please specify)

15. Are there any comments you would like to make?

## GENERAL COMMUNITY SURVEY SUMMARY

| | COUNT 1 | COUNT 2 | COUNT 3 | COUNT 4 | COUNT 5 |
|---|---|---|---|---|---|
| **TOTAL NUMBER OF SURVEY RESPONSES** | **162** | | | | |
| | | | | | |
| **1. Are you a resident in one of the following precincts within the Study Area (refer to map)?** | | | | | |
| Macleay Arm Area Grassy Head / Stuarts Point / Fishermans Reach / Clybucca (Area 4) | 54 | | | | |
| Macleay River Entrance Area: South West Rocks / Jerseyville (Area 3) | 36 | | | | |
| Middle Reach Area: Kinchella / Gladstone / Smithtown (Area 2) | 14 | | | | |
| Upper Reach Area: Frederickton / Kempsey / Greenhill (Area 1) | 34 | | | | |
| | | | | | |
| Please provide your postcode: | | | | | |
| | | | | | |
| **2. If not, where are you from?** | | | | | |
| Elsewhere within the Kempsey Council Area | 10 | | | | |
| Port Macquarie – Hastings Council Area | 4 | | | | |
| Nambucca Council Area | 3 | | | | |
| Elsewhere on the Mid North Coast | 3 | | | | |
| Other area in NSW | 2 | | | | |
| Interstate / Overseas | 2 | | | | |
| | | | | | |
| Please provide your postcode if you are from Australia: | | | | | |
| | | | | | |
| **3. Please indicate how you use the Macleay River estuary area … (tick one or more boxes)** | | | | | |
| Boating (please also complete the attached Recreation Boating Community Survey) | 122 | | | | |
| Swimming | 78 | | | | |
| Picnicking / Walking | 101 | | | | |
| Farming on the floodplain | 4 | | | | |
| Recreational Fishing | 103 | | | | |
| Commercial Fishing | 1 | | | | |
| Aquaculture | 1 | | | | |
| Other (please describe) …. | | | | | |

## GENERAL COMMUNITY SURVEY SUMMARY

**4. Please indicate the importance you place on the following estuary related values…**
*Your answers will help focus the future management of the estuary area.*

| **Very Important = 1, Important = 2, Not Important = 3 & Don't Know = 4** | Very Important | Important | Not Important | Don't Know |
|---|---|---|---|---|
| Boating activities within the estuary (please also complete the attached Recreation Boating Community Survey) | 94 | 41 | 14 | 1 |
| Easy navigation of the river and Macleay Arm by boat (please also complete the attached Recreation Boating Community Survey) | 83 | 45 | 16 | 2 |
| The ability to fish within the estuary | 99 | 39 | 17 | 1 |
| Vehicle or pedestrian access to the river for non-boating activities eg. picnicking / walking | 80 | 66 | 10 | 0 |
| Walking access along the river | 76 | 59 | 20 | 1 |
| Riverside tourist accommodation | 34 | 43 | 73 | 2 |
| Attraction to tourists | 60 | 62 | 25 | 2 |
| Safe swimming locations | 77 | 59 | 18 | 1 |
| Protecting the riverbanks from erosion | 114 | 38 | 4 | 0 |
| Native riverside vegetation | 106 | 43 | 6 | 0 |
| Floodplain backswamps / wetlands | 99 | 46 | 7 | 2 |
| Good water quality in the river | 141 | 19 | 0 | 0 |
| Oyster growing | 65 | 61 | 27 | 2 |
| Historical / cultural values | 53 | 67 | 32 | 2 |

**5. What other features of Macleay River are important to you?**
*(Please describe)*

## GENERAL COMMUNITY SURVEY SUMMARY

**6. Are you happy with current access arrangements to the river, its creeks and adjoining banks?**
*(Indicate Yes/No & comment)*

| **Yes = 1 and No = 2** | Yes | No |
|---|---|---|
| Boat ramps | 99 | 55 |
| *Comment:* | | |
| Vehicle access | 104 | 42 |
| *Comment:* | | |
| Pedestrian access | 99 | 45 |
| *Comment:* | | |
| Disabled access | 66 | 58 |
| *Comment:* | | |

**7. How would you rate the health of Macleay River in regard to …**

| **Very Poor = 1, Poor = 2, Moderate = 3, Good = 4 & Very Good = 5** | Very Poor | Poor | Moderate | Good | Very Good |
|---|---|---|---|---|---|
| Water quality | 3 | 23 | 66 | 51 | 8 |
| Fish populations / aquatic ecosystems | 26 | 40 | 54 | 25 | 3 |
| Riverside vegetation | 18 | 32 | 54 | 40 | 2 |
| Bank stability | 27 | 32 | 60 | 26 | 4 |
| Navigation | 13 | 27 | 56 | 43 | 2 |
| Floodplain backswamps | 32 | 29 | 53 | 25 | 0 |
| Oyster harvest areas | 6 | 16 | 74 | 29 | 0 |
| | 0 | 0 | 0 | 0 | 0 |

**8. What, if any, issues or impacts do you think affect the health of the Macleay River estuary?**
*(Please describe)*

**9. Would you support the creation of fishing sanctuary zones in some critical locations?**

| | |
|---|---|
| Strongly Support | 61 |
| Moderately Support | 33 |
| Do Not Support | 56 |
| Don't Know | 9 |
| *Comment* | |

## GENERAL COMMUNITY SURVEY SUMMARY

**10. Are any of the following issues of concern to you?**

| Very Concerned = 1, Concerned = 2, Un-concerned = 3 & Don't Know -= 4 | Very Concerned | Concerned | Unconcerned | Don't Know |
|---|---|---|---|---|
| Urban / residential development along the river edge | 69 | 50 | 30 | 6 |
| Commercial / industrial development along the river edge | 92 | 44 | 15 | 4 |
| Bank erosion | 81 | 50 | 18 | 3 |
| Lack of riverside vegetation | 63 | 60 | 25 | 6 |
| Overfishing | 83 | 44 | 21 | 8 |
| Acid sulfate soils | 84 | 47 | 12 | 14 |
| Lack of habitat protection | 72 | 51 | 19 | 11 |
| Degraded floodplain backswamps / wetlands | 88 | 42 | 14 | 12 |
| Spread of aquatic weeds | 88 | 53 | 7 | 6 |
| Sea level rise and climate change | 40 | 29 | 80 | 5 |
| Operation of floodgates and drainage works | 79 | 48 | 17 | 10 |
| Dredging of the river | 65 | 47 | 33 | 6 |
| Poor water quality and fish kills after flooding | 97 | 48 | 10 | 4 |
| Protection of the shellfish industry | 57 | 67 | 25 | 5 |
| Scenic amenity | 57 | 60 | 31 | 4 |
| Cultural heritage (indigenous) | 34 | 50 | 65 | 6 |
| Inadequate treatment of stormwater and effluent | 88 | 50 | 12 | 7 |
| Other *(please describe)* | 26 | 0 | 0 | 4 |
| *Comment* | | | | |

**11. Are there any other comments you would like to make?**

## E.4 Stakeholder Consultation

Formal responses received from stakeholders are shown on the following pages.

Northern Rivers CMA CATCHMENT MANAGEMENT AUTHORITY

Your ref: 1352177
Our ref: OUT09/248

Mr. Tim Ruge
Environmental Engineer
GeoLINK
P.O. Box 1446
Coffs Harbour 2450

GeoLINK Received 14/12/09
Project 1352
☐ reviewed
☐ noted file-no action required
☑ action, as follows
scanned → TJM

Dear Tim,

**Re: Macleay River Estuary Management Study and Plan**

Thank you for your letter of 14 September 2009, received by our Authority on 6 November 2009 with the opportunity to contribute to the development of the Macleay River Estuary Management Plan (MREMP).

The Northern Rivers Catchment Management Authority (NRCMA) is involved in the subject area in a variety of roles and capacities, including:

- a NRCMA-funded project, implemented by Kempsey Shire Council to promote adoption of Best Management Practice on the floodplain for acid sulfate soil management. The NRCMA has invested $344,000 in this project between 2006/07 and 2009/10;
- a NRCMA-funded project, implemented by WetlandCare Australia, to undertake wetland property planning in the Clybucca/South West Rocks area;
- two projects that compiled existing knowledge on threatened species in the region's estuaries, including the Macleay;
- an upcoming collaboration with the Macleay oyster growers through a NRCMA industry engagement officer;
- numerous landholder engagements by NRCMA river officers to provide technical advice on erosion and riparian issues, with implementation of onground works such as weed control, revegetation, bank stabilisation and erosion control structures in numerous locations on the floodplain and estuary

Through these and other activities, the NRCMA has identified a number of issues that may be relevant to the upcoming MREMP:

- despite ongoing NRCMA involvement, there is still a need for greater reestablishment of riparian vegetation in the estuary and floodplain, particularly in proximity to freehold farmland. Most of these areas' riparian zones are characterised by a dearth of vegetation and a reliance on rock and engineering solutions to maintain bank stability.
- since early 2009 the Macleay oyster growers have reported several oyster death events (up to 90% mortality), with a particular concentration around the Clybucca area. The causes behind these events appear to relate to flooding and drainage in backswamps and the associated effect on water quality, although this needs to be investigated further. Through our discussions the oyster growers have raised the possibility of creating a Marine Protected area within the Macleay system as a positive step in securing the future of the oyster industry.

- The NRCMA is currently involved in the implementation of Ecohealth – a comprehensive, collaborative ecosystem health monitoring program that will be used throughout the Northern Rivers region. Although the Macleay estuary is not participating at this point (we are only at the pilot stage), we hope that the Macleay will be party to the program at some point in the near future. Ecohealth will align to the State MER process and the State of the Catchments reports, as well as report on NRCMA CAP and State Targets for aquatic biodiversity, water quality of estuaries, riparian/foreshore vegetation and extent of estuarine macrophytes. We hope that GeoLINK can consider this program if water quality/ecosystem health monitoring options or recommendations form part of the MREMP. Carla Sbrocchi (02 6561 4965) is the NRCMA catchment officer guiding this program and she will be happy to discuss this project and provide more information.

- The two NRCMA compilations of threatened species knowledge mentioned above identified a significant knowledge gap with respect to shorebirds in the Macleay estuary. Hard copies of these reports are held at the Kempsey office (contact Roger Stanley – 02 6561 4964) and at the Coffs harbour office (contact Annette Harrison – 02 6653 0114) and are available for review if required.

- The Federal Government's Caring For Our Country business plan is based in part on a structure of "priority coastal hotspots" and "High Value Aquatic Ecosystems". The NRCMA believes that the MREMP should consider the current lack of hotspots/HVAE's in the Macleay region and whether this needs to be addressed

- Given the release of the draft NSW Coastal Planning Guideline: Adapting to Sea Level Rise, we believe the issue of climate change and the effects of predicted sea level rises on the Macleay estuary and floodplain should be addressed by the MREMP.

- An equally important but perhaps underappreciated aspect of predicted climate change is the effect of increased river discharges on the Macleay estuary and floodplain due to increasingly severe rainfall events. The implication is an alteration of current patterns of erosion and deposition, as experienced in the six flood events of 2009. The MREMP should consider the implications of these changes in upstream waterways.

- Finally, the broad issue of community awareness of the estuary and its NRM processes and implications is, as mentioned in your correspondence, an element of the MREMP. The NRCMA fully supports further investigation of this issue and looks forward to a better understanding of community perceptions and their role in the successful management of the estuary.

If you require clarification of our comments or further assistance, please contact Mr Roger Stanley in our Kempsey office on 6561 4964.

Yours sincerely

Michael Pitt

Michael Pitt
General Manager
11 December 2009

GeoLINK
Received 7.12.09
Project 1352
☐ reviewed
☐ noted file-no action required
☑ action, as follows
Scanned
→ TIM

Geolink
PO Box 1446
COFFS HARBOUR NSW 2450

Land and Property Management Authority

98 Victoria Street TAREE NSW 2430
PO Box 440 TAREE NSW 2430
Ph: (02) 65913500
Fax: (02) 6552 2816
Email: terrence.hemmingway@lpma.nsw.gov.au
www.lpma.nsw.gov.au

Date 3 December 2009

Your ref: 1352177

Attention: Mr Tim Ruge

Dear Sir

Re: Macleay Estuary Management Plan

I refer to your letter of 14 September 2009 seeking comment from the Land and Property Management Authority (LPMA) on possible programs and issues to be considered in the Estuary Management Study and resultant Plan.

LPMA is responsible for the administration and management of Crown lands and Crown roads in NSW. The beds of the Macleay and the streams and waterways that comprise the estuary are Crown land, and LPMA has managerial and administrative responsibilities over issues that directly affect the beds (dredging, placement of structures, possible leases, licencing etc). There are also site specific Crown reserves and Crown roads that adjoin the estuary, often forming the banks of the waterways. Many of the waterside reserves are used for passive and active recreation. Most are under the control of Kempsey Shire Council as reserve trust manager. Others are not 'managed' but provide for public access to waterways and other features and also often perform environmental protection functions supporting remnant vegetation and providing corridors and habitat for fauna.

By virtue of this land ownership, the LPMA is a major stakeholder in terms of any proposed activities and planning to be conducted in the estuary. The NSW State Government encourages a whole of government approach from authorities involved in the management/regulation of activities over the estuary hence LPMA works closely with NSW Fisheries, NSW Maritime and DECCW in referencing proposals and prior to authorisation/disallowing land uses.

Over the past few years LPMA has conducted a program whereby groups of coastal reserves have been amalgamated into larger groupings called 'Regional Crown Reserves". The majority of the Macleay estuary is located within the area designated as the "Rocks Regional Crown Reserve". Under the program Plans of Management are prepared for the Regional Reserve to ensure that land use decision making is made in terms of a 'regional' context. LPMA is yet to commence the new management plan for the "Rocks" reserve.

In conjunction with the trust manager, Kempsey Shire Council, LPMA has developed Plans of Management for the 'Horseshoe Bay' reserves that include the estuary foreshore area at Back Creek. A Plan of Management is also being prepared for the 'Mattys Flat' foreshore areas at New Entrance (ie, the southern foreshore area of the Macleay entrance). At both these sites there are significant issues arising from increasing land use pressure, brought about by the significant growth in adjacent residential populations as well as the large episodic influx of holiday and tourist traffic.

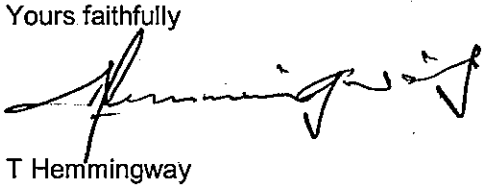
As part of a NSW State Government initiative LPMA has been working closely with Fisheries NSW (Department of Industry and Investment) to implement the NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS). While Fisheries administers and manages 'in water' industry activities, LPMA is responsible for controlling land bases and is an approval authority for lease maintenance dredging. A systematic process has been developed to establish best practice work plans for industry operators, and a more effective compliance regime has been established so as to meet more rigorous

environmental and land management targets. The extent of 'compliance' of Macleay estuary oyster growers with the Strategy has been assessed, and the next step from LPMA perspective will be to introduce work plans, rationalise occupations and introduce a systematic compliance and reporting regime.

Finally, as the landowner, LPMA is a primary stakeholder in terms of the any works proposed in the estuary under the Infrastructure SEPP..

Thank you for the opportunity to comment. If further information is required please contact this Office on phone number 65913513.

Yours faithfully



T Hemmingway
Land Management
Crown Lands Division, Taree

# Appendix F

## Heritage Database List

# AUSTRALIAN HERITAGE PLACES INVENTORY

[ New Search ]

| | | |
|---|---|---|
| 21. | **Public School**<br>Great Northern Rd, Frederickton, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 22. | **Shelter Shed**<br>Great Northern Rd, Frederickton, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 23. | **Smokey Cape Lighthouse Group**<br>Lighthouse Rd, South West Rocks, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 24. | **Smoky Cape Lighthouse**<br>Lighthouse Rd, South West Rocks, NSW | **LGA:** Kempsey Shire<br>**Source:** Commonwealth Heritage List |
| 25. | **Smoky Cape Lighthouse (Commonwealth)**<br>Lighthouse Rd, South West Rocks, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 26. | **Smoky Cape Lighthouse Group**<br>South West Rocks 10km east of, Kempsey, NSW | **LGA:** Kempsey<br>**Source:** NSW Heritage Register |
| 27. | **St Andrew's Presbyterian Church and Hall**<br>67 Smith Street, Kempsey, NSW | **LGA:** Kempsey<br>**Source:** NSW Heritage Register |
| 28. | **The Castles Flora Reserve (No 123)**<br>Comara, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 29. | **Trial Bay Gaol**<br>Cardwell St, South West Rocks, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 30. | **Willi Willi Caves Nature Reserve**<br>Willawarrin, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 31. | **Yarravel Nature Reserve**<br>Armidale Rd, Kempsey, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 32. | **Yessabah Caves Area**<br>Dungay Creek Rd, Kempsey, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |

**Query matched 32 records.**

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Report produced : 16/4/2010
AHPI URL : http://www.environment.gov.au/heritage/ahpi/index.html

# AUSTRALIAN HERITAGE PLACES INVENTORY

[ New Search ]

| | | |
|---|---|---|
| 1. | **Arakoon State Recreation Area**<br>Carri St, South West Rocks, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 2. | **Bellbrook Conservation Area**<br>Bellbrook, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 3. | **Bridge over Five Day Creek**<br>Main Road 75, Kempsey, NSW | **LGA:** Kempsey<br>**Source:** NSW Heritage Register |
| 4. | **Clybucca Aboriginal Area**<br>South West Rocks, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 5. | **Clybucca Nature Reserve Proposal**<br>Pacific Hwy, Clybucca, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 6. | **Frederickton Public School Group**<br>Great Northern Rd, Frederickton, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 7. | **Gladstone Courthouse and Police Station**<br>Kinchela St, Gladstone, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 8. | **Hat Head National Park (1977 boundary)**<br>Hat Head, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 9. | **Headmasters Residence**<br>Great Northern Rd, Frederickton, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 10. | **Indigenous Place**<br>Willawarrin, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 11. | **Indigenous Place**<br>South West Rocks, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 12. | **Indigenous Place**<br>Stuarts Point, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 13. | **Indigenous Place**<br>Bellbrook, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 14. | **Indigenous Place**<br>Bellbrook, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 15. | **Kempsey Courthouse**<br>Kemp St, Kempsey, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |

| | | |
|---|---|---|
| 16. | **Kempsey Post Office**<br>Belgrave St, Kempsey, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |
| 17. | **Kempsey Post Office**<br>Belgrave Street, Kempsey, NSW | **LGA:** Kempsey<br>**Source:** NSW Heritage Register |
| 18. | **Kempsey rail bridge over Macleay River**<br>North Coast railway, Kempsey, NSW | **LGA:** Kempsey<br>**Source:** NSW Heritage Register |
| 19. | **Kempsey Railway Station group**<br>North Coast railway, Kempsey, NSW | **LGA:** Kempsey<br>**Source:** NSW Heritage Register |
| 20. | **Pipers Creek Lime Kilns**<br>Bonnie Corner Rd, Kundabung, NSW | **LGA:** Kempsey Shire<br>**Source:** Register of the National Estate |

**Query matched 32 records.**

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[1][2] [Next Page>>]

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Report produced : 16/4/2010
AHPI URL : http://www.environment.gov.au/heritage/ahpi/index.html

# Search Results

**5 results found.**

| | | |
|---|---|---|
| Arakoon State Recreation Area Carri St | South West Rocks, NSW, Australia | (Registered) Register of the National Estate |
| Clybucca Aboriginal Area | South West Rocks, NSW, Australia | (Registered) Register of the National Estate |
| Clybucca Nature Reserve Proposal Pacific Hwy | Clybucca, NSW, Australia | (Registered) Register of the National Estate |
| Kempsey Post Office 3-5 Smith St | Kempsey, NSW, Australia | (Indicative Place) Commonwealth Heritage List |
| Kempsey Post Office Belgrave St | Kempsey, NSW, Australia | (Registered) Register of the National Estate |

**Report Produced: Fri Apr 16 13:12:33 2010**

Click on the BACK button of your browser to return to the search.

# Statutory Listed Items

Information and items listed in the State Heritage Inventory come from a number of sources. This means that there may be several entries for the same heritage item in the database. For clarity, the search results have been divided into two sections.

- **Section 1**. contains items listed by the **Heritage Council** under the NSW Heritage Act. This includes listing on the State Heritage Register, an Interim Heritage Order or protected under section 136 of the NSW Heritage Act. This information is provided by the Heritage Branch.
- **Section 2**. contains items listed by **Local Councils & Shires and State Government Agencies**. This section may also contain additional information on some of the items listed in the first section.

## Section 1. Items listed under the NSW Heritage Act.

Click on an item name to view the full details.
The search results can be re-sorted by clicking on the **(sort)** option at the top of each column.

| Item Name (sort) | Address (sort) | Suburb (sort) | LGA (sort) | Listed Under Heritage Act |
|---|---|---|---|---|
| Bridge over Five Day Creek | Main Road 75 | Kempsey | Kempsey | Yes |
| Gondwana Rainforests of Australia | | Various | Upper Hunter | Yes |
| Kempsey Post Office | Belgrave Street | Kempsey | Kempsey | Yes |
| Kempsey rail bridge over Macleay River | North Coast railway | Kempsey | Kempsey | Yes |
| Smoky Cape Lighthouse Group | South West Rocks 10km east of | Kempsey | Kempsey | Yes |
| South West Rocks Pilot Station Complex | 5 Ocean Drive | South West Rocks | Kempsey | Yes |
| St Andrew's Presbyterian Church and Hall | 67 Smith Street | Kempsey | Kempsey | Yes |

There were **7** records in this section matching your search criteria.

## Section 2. Items listed by Local Government and State agencies.

| Item Name (sort) | Address (sort) | Suburb (sort) | LGA (sort) | Information Source (sort) |
|---|---|---|---|---|
| Fredrickton Public School group | Great North Road | Frederickton | Kempsey | GAZ |
| Kempsey Bridge (Macleay River) | | Kempsey | Kempsey | SGOV |
| Kempsey District Hospital | River Street | Kempsey | Kempsey | SGOV |

| | | | | |
|---|---|---|---|---|
| **Kempsey Station Group** | | Kempsey | Kempsey | SGOV |
| **New England National Park** | | (not given) | Kempsey | GAZ |
| **Oddfellows Hall** | 22 Kemp Street | Kempsey | Kempsey | GAZ |
| **Pacific Guest House** | 21-23 Livingstone Street | South West Rocks | Kempsey | GAZ |
| **Pipers Creek lime kilns** | Ballengarra State Forest | Kundabung | Kempsey | GAZ |
| **Primary School Group, classroom, residence, shed** | | Yarrahapinni | Kempsey | GAZ |
| **Trial Bay Gaol & German graves** | The Ruins Way | Arakoon | Kempsey | GAZ |

There were **10** records in this section matching your search criteria.

There was a total of **17** records matching your search criteria.

**Key:**
LGA = Local Government Area
GAZ= NSW Government Gazette (statutory listings prior to 1997), HGA = Heritage Grant Application, HS = Heritage Study, LGOV = Local Government, SGOV = State Government Agency.

**Note:** The Heritage Branch seeks to keep the State Heritage Inventory (SHI) up to date, however the latest listings in Local and Regional Environmental Plans (LEPs and REPs) may not yet be included. Always check with the relevant Local Council or Shire for the most recent listings.