



BYRON SHIRE COUNCIL

Coastal Zone Management Plan for the Brunswick Estuary Issue No. 5, June 2017



BYRON SHIRE COUNCIL
COASTAL ZONE MANAGEMENT PLAN FOR THE
BRUNSWICK ESTUARY

Issue No. 5
JUNE 2017

Document Amendment and Approval Record

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3	Final Estuary Management Plan re-named as Coastal Zone Management Plan for the Brunswick Estuary, Res 10-575 – Addendum 1 (#998403 Word, #1006451 pdf),	G. McLean (31/08/2010)	B.Fitzgibbon (31/08/2010)	B. Fitzgibbon (31/08/2010)
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FOREWORD

The estuaries of New South Wales are a highly prized natural resource. They offer immense value from an ecological, social and economic perspective. Estuarine foreshores are desirable places on which to live and work and their waterways are popular for a wide variety of active and passive recreational pursuits.

NSW has over 130 estuaries that vary in size from small coastal creeks and lagoons to large lakes and rivers. Similarly, the State's estuaries vary widely in their natural attributes, degree of development, and their use and productivity.

In recognition of the ecological, social and economic importance of this State's estuaries and concern about their degradation, the NSW Government has developed the Coastal and Estuary Grants Program. The primary objective of this program is to support local government in managing the risks from coastal hazards, restoring degraded coastal habitats and improving the health of NSW estuaries, wetlands and littoral rainforests.

Under the Government's Coastal and Estuary Grants Program, financial and technical assistance is provided to local councils to prepare and implement coastal zone management plans (CZMPs) for estuaries within their local government area. The *Guidelines for Preparing Coastal Zone Management Plans* by the Office of Environment and Heritage (2013) provides guidance and the management process for preparing coastal zone management plans for estuaries.

The Brunswick Estuary on the far north coast of NSW is a special place to the local community and is highly valued for its natural, cultural and ecological attributes.

This CZMP for the Brunswick Estuary has been prepared by Byron Shire Council and presents the methodology and mechanism for Council to manage the estuary into the future.

The CZMP is founded on the Brunswick Estuary Study (2002) which outlines the physical, chemical and biological processes within the estuary and the impact of human activities on these processes. The precursor of the CZMP is the Brunswick Estuary Management Study and Plan (2007), which identifies and prioritises estuary management issues, values, objectives and strategies.

With increased knowledge and through on-going monitoring our understanding of the Brunswick Estuary and estuaries in general will improve. Accordingly, the CZMP for the Brunswick Estuary will need to be reviewed and amended to account for changing environmental conditions, community desires and management responses.

Richard Hagley

NSW Office of Environment and Heritage

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1 About the CZMP

1.1 History of the CZMP

This *Coastal Zone Management Plan for the Brunswick Estuary (Issue No. 5)* has a long history and was previously called the *Brunswick Estuary Management Plan*. The Brunswick Estuary Management Plan (BEMP) was finalised in October 2008 and adopted by Byron Shire Council (Council) on the 13 November 2008. The BEMP was submitted to the then Minister for Climate Change and the Environment, the Hon Carmel Tebbutt MP, on 4 February 2009 for approval under Section 55G of the *Coastal Protection Act 1979* (the Act).

On 25 June 2010 Council received a request from the Department of Environment, Climate Change and Water (now the Office of Environment and Heritage) to rename the BEMP to the “*Coastal Zone Management Plan for the Brunswick Estuary (CZMP)*”. This amendment was applied on 31 August 2010 and the CZMP was finalised. The CZMP was re-submitted on the 16 September 2010 to the then Minister for Climate Change and Environment, Frank Sartor for approval under the Act.

In January 2011 amendments to the Act took effect and ministerial certification of the plan was required, as opposed to approval. The Office of Environment and Heritage (OEH) assessed the CZMP as part of the certification process requesting additional information including written correspondence with public authorities involved in the plan affected by proposed actions to give consent. OEH also requested Council re-submit the CZMP to the new Minister for the Environment Robyn Parker. In addition, due to the significant period of time passing, dates of the management actions and strategies were unrealistic.

Final amendments were made to the CZMP and Council re-submitted the CZMP on 30 August 2012 (Issue 4).

In July 2013, new statutory Guidelines for Preparing Coastal Zone Management Plans were introduced by OEH, replacing the Estuary Management Manual (NSW Government 1992) for which the CZMP was developed in accordance with. Along with the introduction of these guidelines the NSW coastal legislation was reformed at a similar time thereby contributing to the slow progression of the CZMP through the ministerial certification process.

In 2016, Council enquired as to the status of the CZMP in the certification process as a significant amount of time had passed since submission. Unfortunately, the CZMP was deemed to be too out of date for certification. In order to seek ministerial certification, the plan required a complete review and update and re-submission prior to the repeal of the current coastal legislation which is estimated to occur in mid 2017 (refer to **Appendix A**).

1.2 Review and Update of the CZMP

In January 2017, Council undertook a complete review and update of the CZMP in effort to re-submit the plan for ministerial certification before the legislation repeal date.

This CZMP (Issue No.5) is the product of the review and update of the previous Issue No. 4. The process of the review and update of the CZMP undertaken by Council is outlined in **Table 1-1** below.

Table 1-1 – Outline of the review and update of the CZMP.

Review and Update	
Objective	Method
1. To gather sufficient information on the status of the Brunswick Estuary and to determine whether many of the management strategies proposed in the implementation schedule of CZMP (Issue No. 4, 2012) adopted in 2008 have been completed, are presently underway, or are not relevant anymore.	A complete audit of all the management strategies outlined in the CZMP (Issue No. 4, 2012) was undertaken by Council using desktop analysis of Council documents, liaising with various Council departments and discussion with public agencies and stakeholders.
Site Survey	
Objective	Method
<ol style="list-style-type: none"> To gain an understanding of the present day issues facing the Brunswick Estuary and determine the locations where on-ground works (such as bank stabilisation works and/or riparian vegetation) are required. To investigate whether bank erosion site allocated in the CZMP (Issue 4, 2012) are still experiencing significant and active bank erosion. 	A three day vessel based site survey of the Brunswick Estuary was completed in the tidal reaches of Simpson Creek, Marshalls Creek and the main arm of the Brunswick River (incl. Salt Water Creek). The method involved recording the condition of the creek and river bank at areas where bank erosion was visible, recommending a management response and assigning an action with a priority ranking. The site survey was completed twice to ground truth the sites and ensure management responses were assigned realistic and implementable actions and priorities.
Update of CZMP document	
Objective	Method
<ol style="list-style-type: none"> To update the document to reflect the outcomes of the audit and site survey completed. To set realistic and current timeframes and estimated costs for implementation of strategies. To update the document to reflect changes in legislation, government agencies, policies and more recent technical information available. 	<p>An editorial update was completed with new chapters included in the revised document, and information updated or deleted if not relevant. This update included, but was not limited to:</p> <ol style="list-style-type: none"> Update of all public agencies proposed to undertake actions/strategies for implementation. Update of all policies, legislation and coastal framework. Update of the cost of management strategies proposed to reflect time passed and increase in cost estimates. Update of timeframes and proposed dates for commencement of each management strategy. A description of how the CZMP meets the minimum requirements of the Guidelines for Preparing Coastal Zone Management Plans under Act.

Complete results of the Audit and Site Survey are presented in **Appendix B**.

1.3 Management Area

The CZMP has been prepared for the Brunswick Estuary and its tributaries, located in Northern New South Wales (NSW) approximately 800 kilometres north of Sydney. The management area includes the tidal waters, foreshores and adjacent lands of the Brunswick Estuary which is located within the Byron Shire Local Government Area (LGA) and falls within the Cape Byron Marine Park. The Cape Byron Marine Park was declared in November 2002.

The estuary drains a catchment area of about 228 km² and has a waterway area of 2.2 km² extending from the ocean entrance at Brunswick Heads upstream to the tidal limits. The extent of the Brunswick River catchment is shown in **Figure 1-1**. This report focuses on the tidal waters, foreshores and adjacent lands of the Brunswick Estuary, extending from the ocean entrance at Brunswick Heads upstream to the tidal limits. The extent of the estuary is shown **Figure 1-2**.

A more detailed description of the management area is described in **Section 3**.

1.4 Purpose of the CZMP

The purpose of this CZMP is to set in place policies, strategies and actions for Council's long term future management of the Brunswick Estuary. To do this, the CZMP draws upon information gained from previously completed estuary process studies, management studies, and public and expert consultation. The CZMP considers this information and presents management strategies for the balanced and integrated management of the estuary and its resources.

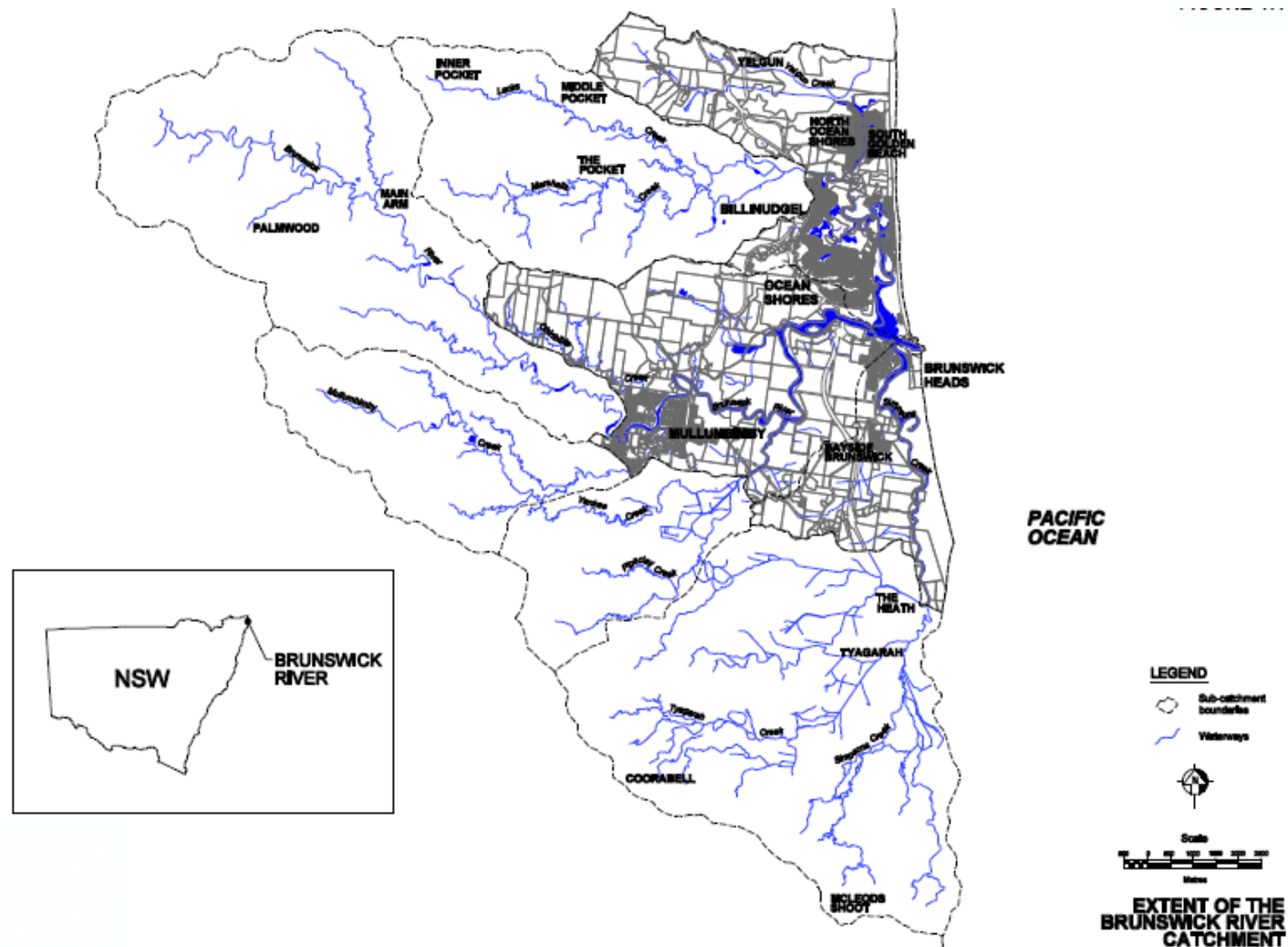


Figure 1-1 – Extent of the Brunswick River Catchment

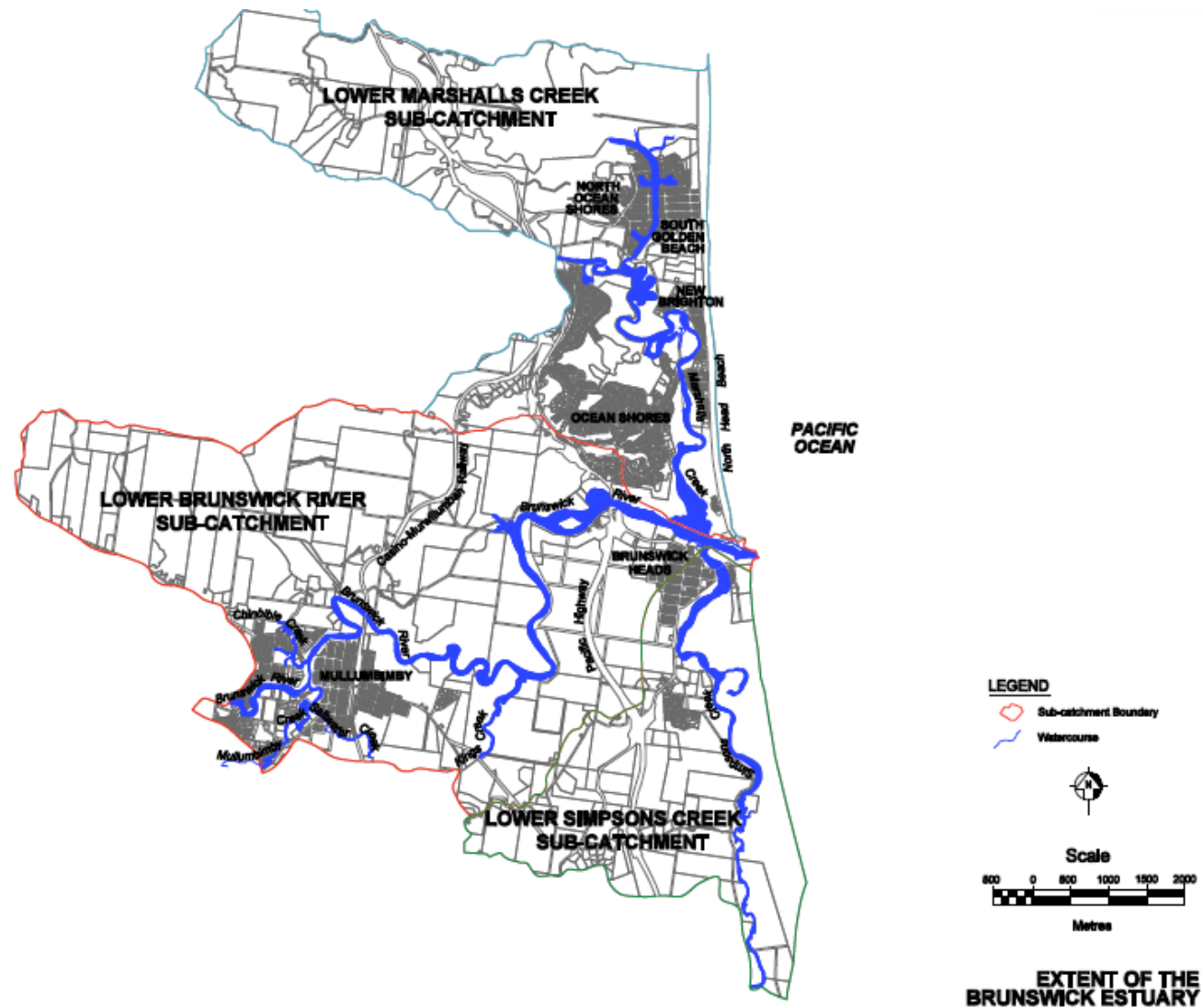


Figure 1-2 – Extent of the Brunswick Estuary

2 The Estuary Management Framework

2.1 Estuary Management Process

The NSW Coastal Protection Act 1979 provides for the 'protection of the coastal environment of the State for the benefit of present and future generations'.

The objects of the Act relate to such matters as:

- the protection and rehabilitation of coastal environments
- the ecologically sustainable development and use of the State's coastal resources
- the promotion of amenity and public access to the coast
- ensuring the co-ordination of the policies and activities of the Government and public authorities in order to facilitate the proper integration of their management activities in the coastal zone, and
- to encourage the development of adaptation strategies in response to coastal climate change impacts such as sea level rise.

Under Part 4A of the Act, CZMPs can be prepared by local Government with the support of OEH. The plans are required to consider the management of threats to estuary health, as well as the potential impacts of climate change, and must be prepared in consultation with the key stakeholders and the community.

In 1992, the NSW State Government introduced an Estuary Management Policy aimed at managing the growing pressures on estuarine ecosystems. The Estuary Management Policy provided for the assessment of all estuarine uses, the resolution of conflicts, and the goal of producing a unified and sustainable Estuary Management Plan for each estuary (NSW Government, 1992). The Estuary Management Policy was implemented on the Brunswick Estuary through a process which involved the establishment of a Brunswick Estuary Management Committee (hereafter referred to as "the Committee") which was to be chaired by Byron Shire Council. The Committee was responsible for carrying out the steps in the process toward development and finalisation of an Estuary Management Plan.

In February 2003, amendments to the Coastal Protection Act, 1979, came into effect. One of the amendments relates to the need for preparation of CZMPs. These plans (once complete) need to be referred to the Minister for the Environment for approval and if approved must be published in the Government Gazette.

The development of the CZMP and illustration of the coastal zone management process and the requirements is presented in and **Figure 2-1** and **Table 2-1**.

It is noted that the first step of the process was completed under the previous 1992 Estuary Management Manual, however, the CZMP (Issue 5) has been reviewed and updated in accordance with the 2013 Guidelines.

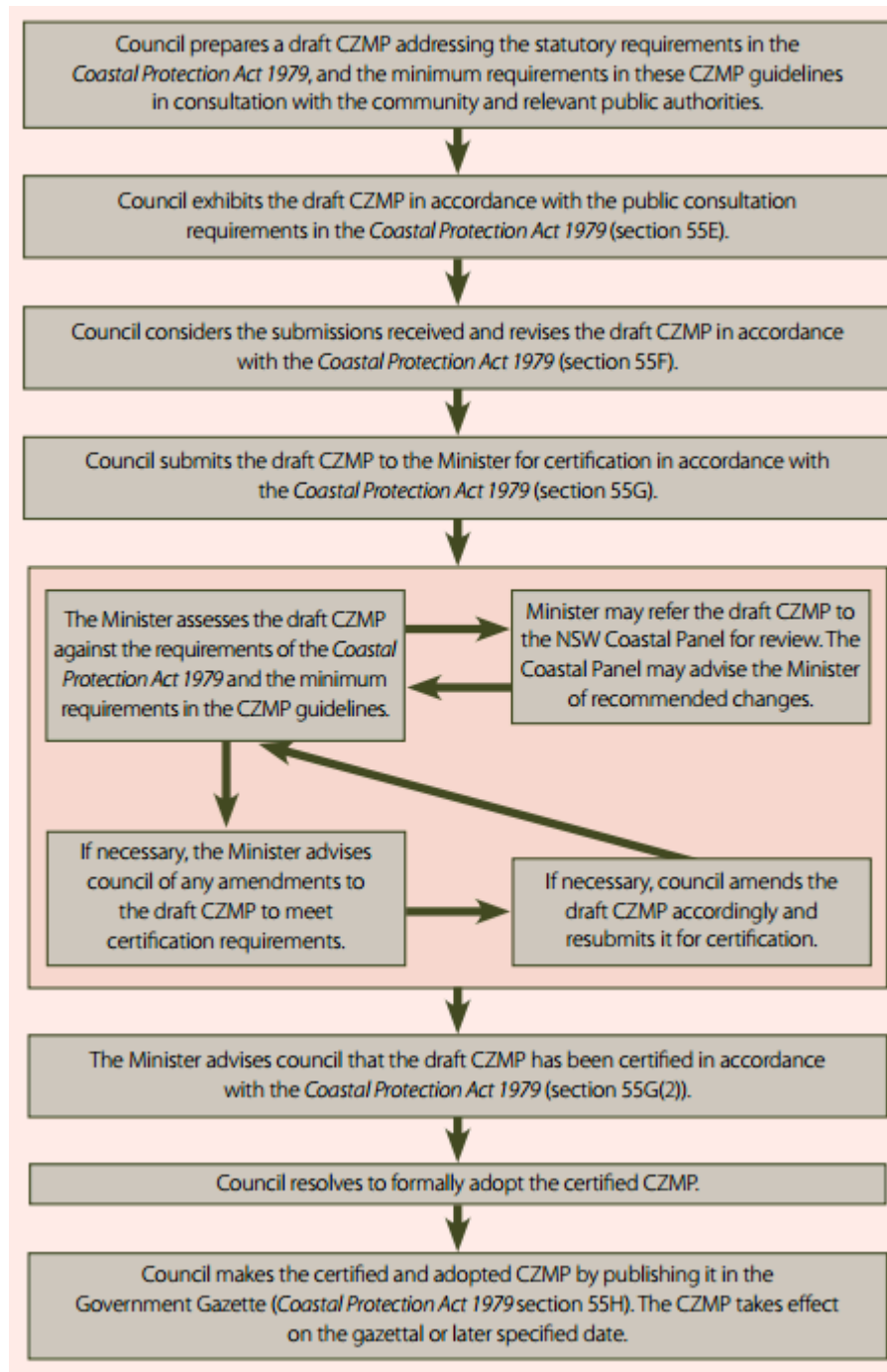


Figure 2-1 CZMP preparation and certification process from the Guidelines for Preparing Coastal Zone Management Plans (OEH, 2013).

Table 2-1 – Completed stages of the CZMP preparation process

Stage	Stage	Status of the CZMP for the Brunswick Estuary
1	Council prepares a draft CZMP addressing the statutory requirements in the <i>Coastal Protection Act 1979</i> , and the minimum requirements in the 2013 Guidelines in consultation with the community and relevant public authorities.	<p>Brunswick Estuary Management Committee established in June 1997.</p> <p>Data compilation study Brunswick Catchment Report completed in 1998 (Alderson & Associates, 1998).</p> <p>Estuary process and estuary management study completed in 2002 which produced the comprehensive Brunswick Estuary Management Study (MHL, 2002).</p> <p>Draft Brunswick Estuary Management Study and Plan developed through consultation with the Committee (Patterson Britton and Partners, 2004).</p>
2	Council exhibits the draft CZMP in accordance with the public consultation requirements in the <i>Coastal Protection Act 1979</i> (Section 55E).	Draft Brunswick Estuary Management Study and Plan publicly exhibited from 6 January 2006 until 31 March 2006.
3	Council considers the submissions received and revises the draft CZMP in accordance with the Coastal Protection Act 1979 (section 55F).	<p>Public submissions and responses were received up until the end of March 2006.</p> <p>Council subsequently compiled and assessed the submissions to establish key issues of concern, documenting the Brunswick Estuary Management Plan Public Exhibition Report (V. 2, August 2006).</p> <p>The plan was amended and completed as a final draft in 2007. However, as it was a large complex document, Council resolved in Dec 2007 to produce a “slimline” version of the Brunswick Estuary Management Study and Plan. The extracted slimline document was named the Brunswick Estuary Management Plan (BEMP).</p> <p>The draft BEMP was finalised on 7 October 2008 and adopted by Council on 13 November 2008.</p>
4	Council submits the draft CZMP to the Minister for certification in accordance with the Coastal Protection Act 1979 (section 55G).	<p>BEMP submitted for approval under the Act on 4 February 2009.</p> <p>The BEMP was renamed CZMP on 31 August 2010.</p> <p>CZMP re-submitted for approval under the Act on 16 September 2010.</p> <p>Amendments made to CZMP and re-submitted on 30 August 2012.</p> <p>Reviewed and updated in 2017 for re-submission and Ministerial certification.</p>

The guidelines identify a series of Coastal Management Principles that were developed to inform strategic coastal zone management.

Table 2-2 outlines each of the Coastal Management Principles that have been addressed in this CZMP and provides cross references to the relevant report section. This CZMP endeavours to

address these principles to the fullest extent possible within the scope of works for the project, acknowledging that the principles were released after commencement of this project.

Table 2-2 – Consideration of the Coastal Management Principles

Coastal Management Principle	Consideration by the CZMP	Report Section
<p>Principle 1</p> <p>Consider the objectives of the Coastal Protection Act 1979 and the goals, objectives and principles of the NSW Coastal Policy 1997.</p>	<p>The CZMP was prepared under guidance of the Estuary Management Manual and is in accordance with principles and objectives of the Estuary Management Policy, 1992. However, it is also consistent with the goals and objectives of the Act and the NSW Coastal Policy 1997.</p>	<p>Refer - Section 1, Brunswick Estuary Management Study and Plan, Issue No. 5 (2007)</p>
<p>Principle 2</p> <p>Optimise links between plans relating to the management of the coastal zone.</p>	<p>The relationship between the CZMP and existing plans and strategies is covered in depth in the Brunswick Estuary Management Study and Plan (2007)</p>	<p>Refer - Section 6, Brunswick Estuary Management Study and Plan, Issue No. 5 (2007)</p>
<p>Principle 3</p> <p>Involve the community in decision making and make coastal information publicly available.</p>	<p>Extensive community consultation was developed and completed during the formation of the CZMP.</p>	<p>Appendix E</p> <p>Refer - Section 2, Brunswick Estuary Management Study and Plan, Issue No. 5 (2007)</p>
<p>Principle 4</p> <p>Base decisions on the best available information and reasonable practise; acknowledge the inter-relationship between catchment, estuarine and coastal processes; adopt a continuous improvement management approach.</p>	<p>The Brunswick River Estuary Study (2002) provides scientific understanding of the hydraulic, sedimentation, water quality and ecological processes within the estuary, and the impacts of human activities on these processes. The Brunswick Estuary Management Study and Plan (2007) identifies the essential features and the current uses of the estuary, and determines the overall objectives required for management of the estuary. The Management Study and Plan identifies options for meeting these objectives, and determines hydraulic and ecological impacts of the proposed options.</p>	<p>Refer - Brunswick River Estuary Study, Summary Report (2002)</p> <p>Refer - Brunswick Estuary Management Study and Plan, Issue No. 5 (2007)</p>

Coastal Management Principle	Consideration by the CZMP	Report Section
<p>Principle 5</p> <p>The priority for public expenditure is public benefit; public expenditure should cost effectively achieve the best practical long-term outcomes.</p>	<p>The Management Study and Plan priorities the variety of management strategies that have been determined to address the management objectives for the estuary. The actions/strategies aim to protect significant areas of the estuary and improve aspects of the estuary to make it more suitable for existing and future waterway users. The proposed actions have been prioritised to address the issues facing the estuary and are cost effective, realistic and implementable. As the CZMP was prepared under the Estuary Management Manual, a triple bottom line assessment or cost benefit analysis has not been undertaken on the management options presented.</p>	<p>Refer - Section 9, Brunswick Estuary Management Study and Plan, Issue No. 5 (2007)</p>
<p>Principle 6</p> <p>Adopt a risk management approach to managing risks to public safety and assets; adopt a risk management hierarchy involving avoiding risk where feasible and mitigation where risks cannot be reasonably avoided; adopt interim actions to manage high risks while long-term options are implemented.</p>	<p>Risk to public safety, assets, and ecological health have been assessed in a largely qualitative fashion, through the consideration of estuary processes and management issues.</p>	<p>Refer - Brunswick River Estuary Study, Summary Report (2002) and Brunswick Estuary Management Study and Plan, Issue No. 5 (2007)</p>
<p>Principle 7</p> <p>Adopt an adaptive risk management approach if risks are expected to increase over time, or to accommodate uncertainty in risk predictions.</p>	<p>Management actions have been broadly prioritised based on their expected performance in reducing the identified risks (i.e. water quality, riparian vegetation loss, user conflicts etc). The CZMP will be monitored and reviewed consistent with an adaptive management framework as strategies are implemented and the project is executed.</p>	<p>See Section 3.4 and 3.5</p>
<p>Principle 8</p> <p>Maintain the condition of high value coastal ecosystems; rehabilitate priority degraded coastal ecosystems.</p>	<p>A primary management objective of the CZMP is to improve estuary ecological health and biodiversity though the implementation of management actions and strategies such as bank stabilisation works, revegetation and research and monitoring.</p>	<p>Section 3.4 and Section 4</p>

Coastal Management Principle	Consideration by the CZMP	Report Section
<p>Principle 9</p> <p>Maintain and improve safe public access to beaches and headlands consistent with the goals of the NSW Coastal Policy.</p>	<p>The CZMP seeks to The CZMP presents specific management actions to be implemented to promote recreational amenity and public access to the coast.</p>	<p>Section 2 and Section 4</p>
<p>Principle 10</p> <p>Support recreational activities consistent with the goals of the NSW Coastal Policy.</p>	<p>The CZMP seeks to promote improved coordination between initiatives of various agencies to provide for recreational amenity in the study area. The CZMP presents specific management actions to be implemented to improve the recreational amenity of the estuary and foreshore areas.</p>	<p>Section 2 and Section 4</p>

2.2 Strategic Vision

This CZMP aims to:

1. Promote the aim of the previous NSW Estuary Management Policy which is “to achieve integrated, balanced, responsible and ecologically sustainable use of the state’s estuaries within an overall catchment management perspective”. To facilitate and guide the long-term sustainable use of the Brunswick Estuary system as an integral component of the State’s natural systems which supports a great diversity of terrestrial and estuarine species, human activities and cultural and social values.
2. Address the minimum requirements of the Guidelines for Preparing CZMP’s (OEH, 2013) by supporting the goals and objectives of the NSW Coastal Policy 1997, and the objects of the *Coastal Protection Act 1979*.

2.3 Goals

The CZMP presents specific management measures that can be implemented to address the key issues confronting the future management of the estuary as identified in the “Brunswick River Estuary Study” (Byron Shire Council, 2002) and the Brunswick Estuary Management Study and Plan (BSC, 2007). The CZMP also documents the essential features that make the estuary unique and prioritises objectives and options for the future management of the estuary. Potential strategies for achieving these objectives are listed, along with any impacts that these strategies may have on critical estuary processes.

While the Brunswick River Estuary Study was completed back in 2002, and the Brunswick Estuary Management Study and Plan completed in 2007, it is considered that the vast majority of the identified issues still remain relevant today upon which the objectives and management strategies of this CZMP are built.

The CZMP documents the strategies and actions that will achieve the following specific objectives:

- (i) protect, rehabilitate and improve the natural estuarine environment
- (ii) manage the estuarine environment in the public interest to ensure its health and vitality

- (iii) improve the recreational amenity of estuarine waters and foreshores
- (iv) recognise and accommodate natural processes and climate change
- (v) ensure the ecological sustainable development and use of resources.

The CZMP has been structured to provide a list of strategic measures that can be implemented across the management area defined in **Figure 1-2** in order to meet the objectives determined by legislative guidelines and through consultation with key stakeholders. Management Strategies are detailed in **Section 4**.

2.4 Duration

The CZMP should be reviewed on a cycle of five to ten years. The CZMP may be amended at an earlier date if circumstances change such as legislative changes, new knowledge of climate change, or if new data becomes available on estuarine science/management that may affect the CZMP.

Under the provisions of the *Coastal Management Act 2016*, once the CZMP is approved by the Minister for the Environment it remains in force until 31 December 2021 when it may be transitioned into a Coastal Management Program (CMP), should Council choose to embark on this process.

2.5 Management Agencies and Legislation

2.5.1 Agencies

The prime responsibility for the implementation of this CZMP is held with Byron Shire Council, in consultation with the Byron Shire community. Technical and funding assistance for implementation of the Plan is provided by the NSW Office of Environment and Heritage.

There are other organisations and/or divisions that have a direct responsibility for the implementation of this CZMP and the complete list is considered to include:

- Byron Shire Council
- Department of Industry – Lands
- NSW Crown Holiday Parks Trust
- NSW Department of Primary Industries - Marine Parks
- NSW Department of Primary Industries – Fisheries
- Brunswick Valley Landcare

Other organisations with activities and responsibilities relevant to management of the Brunswick Estuary and its catchment include:

- Bundjalung of Byron Bay Aboriginal Corporation (Arakwal)
- Roads and Maritime Services
- Department of Planning
- National Parks and Wildlife Service
- NSW Department of Primary Industries
- Telstra
- Department of Industry - Resources and Energy
- Department of Finance, Service and Innovation
- Health Commission of NSW

- North Coast Local Land Services
- North Coast Weeds

2.5.2 Planning Controls

Land use in the Brunswick Estuary is controlled by a range of legislation, planning instruments and regulations, which are administered by government agencies at both the local and state level. The following sections provide a summary of the environmental and land use Acts and Regulations applicable within NSW. In addition to these Acts and Regulations there are also State Environmental Planning Policies (SEPP), regional environmental plans (REPs), local environmental plans (LEPs), development control plans (DCPs), and regional vegetation management plans (RVMPs).

A summary of environmental and land use legislation applicable within NSW is provided in **Appendix C**.

2.5.3 Relationship to Other Plans and Strategies

There is a large variety of existing and current plans and strategies relevant to the management of the Brunswick Estuary. The relationship between the CZMP and these documents is covered in depth in the Brunswick Estuary Management Study and Plan (2007). These documents are listed below.

- Byron Shire Council Operational Plan (2016/17)
- Byron Shire Council Delivery Program (2013 – 2017)
- Byron Local Environmental Plan 1998
- Byron Local Environmental Plan 2014
- Byron Development Control Plans 2010
- Byron Development Control Plans 2014
 - DCP (2014) Part E: Chapter E3 – Mullumbimby
 - DCP (2014) Part E: Chapter E4 – Brunswick Heads
 - DCP (2010) Chapter 6: Bayside Brunswick Estate
- Byron Shire Bike Strategy and Action Plan (Bike Plan) 2008
- Draft Northern Rivers Catchment Action Plan 2013-2023
- Brunswick Heads Settlement Strategy 2004
- Mullumbimby Settlement Strategy 2003
- Byron Rural Settlement Strategy 1998
- Byron Rural Land Use Strategy 2016
- Byron Shire Urban Stormwater Management Plan 2002
- Cape Byron Marine Park Planning Scheme 2006
- Brunswick Wastewater Management Strategy
- Byron On-site Sewage Management Strategy 2002
- Byron Shire Sustainable Agriculture Strategy 2004
- Byron Biodiversity Conservation Strategy 2004
- Brunswick Heads Foreshore Reserves Strategic Plan 2008

- Plan of Management for Brunswick Heads Foreshore Public Reserves at Brunswick Heads 2014

2.5.4 Supporting Documents

The Development of the Brunswick Estuary Management Plan has been preceded by the completion of the following documents which provide the information from which this Plan directly draws.

- Brunswick Catchment Report (1998) - was completed for the Brunswick Catchment Management Committee and includes an extensive compilation of data and studies undertaken in the Brunswick River catchment and estuary.
- Brunswick River Estuary Study (2002) - outlines all the hydraulic, sedimentation, water quality and ecological processes within the estuary, and the impacts of human activities on these processes.
- Brunswick Estuary Management Study and Plan (2007) - identifies the essential features and the current uses of the estuary, and determines the overall objectives required for management of the estuary. The Management Study and Plan identifies options for meeting these objectives, and determines hydraulic and ecological impacts of the proposed options.

3 About the Management Area

3.1 Key Features and Values

The Brunswick Estuary comprises three primary arms, namely:

- the main arm, which includes the Brunswick River and Kings Creek, both of which have their headwaters to the west of Mullumbimby and flow east to the ocean at Brunswick Heads
- the north arm, which is known as Marshalls Creek
- the south arm, known as Simpsons Creek.

The ecological value of the estuary is unique. This is because the Lower Brunswick River and Marshalls and Simpsons Creeks all fall within the Cape Byron Marine Park. This makes the waterway significant in both a local and regional sense.

Similarly, the Tyagarah and Brunswick Heads Nature Reserves are important coastal mainland reserves on the far north coast of NSW. Together with the Broken Head Nature Reserve, these three reserves form the Byron Coast Group of Nature Reserves. They are regionally significant as wildlife corridors for north-south migration along the NSW coast (NPWS, 1998).

The Marshalls Creek Nature Reserve borders the mid-to upper areas of Marshalls Creek. In addition, there are significant areas of wetland along both Simpsons and Marshalls Creeks, and along the lower Brunswick River (refer Figure 3-1). As shown in **Figure 3-1** three pockets of littoral rainforest exist to the west of Marshalls Creek. These areas are protected under SEPP legislation, which highlights their significance at both a state and regional level.

Aboriginal people have lived on the north coast of NSW for thousands of years. A significant number of Aboriginal sites and places are known throughout the valley and especially around Byron Bay and Brunswick Heads where there is remaining evidence of campsites and associated middens or feasting grounds suggesting a population of many hundreds prior to European arrival.

The features which define the natural and cultural significance of an estuary are those which make the estuary important in a local, regional or national sense. During the development of the CZMP a list of features was outlined for each of the following categories of estuary attributes:

- Aesthetic attributes
- Ecological attributes
- Social attributes
- Economic attributes.

Ecological, aesthetic and some social attributes are highly valued while economic attributes were assigned a low value. This reflects the predominantly natural characteristics of the estuary catchment and highlights the importance placed by the Committee on the ecological attributes of the estuary and the adjoining estuarine catchment.

Further details and description on the location and setting, history and natural and cultural significance of the estuary is outlined in **Appendix D**.

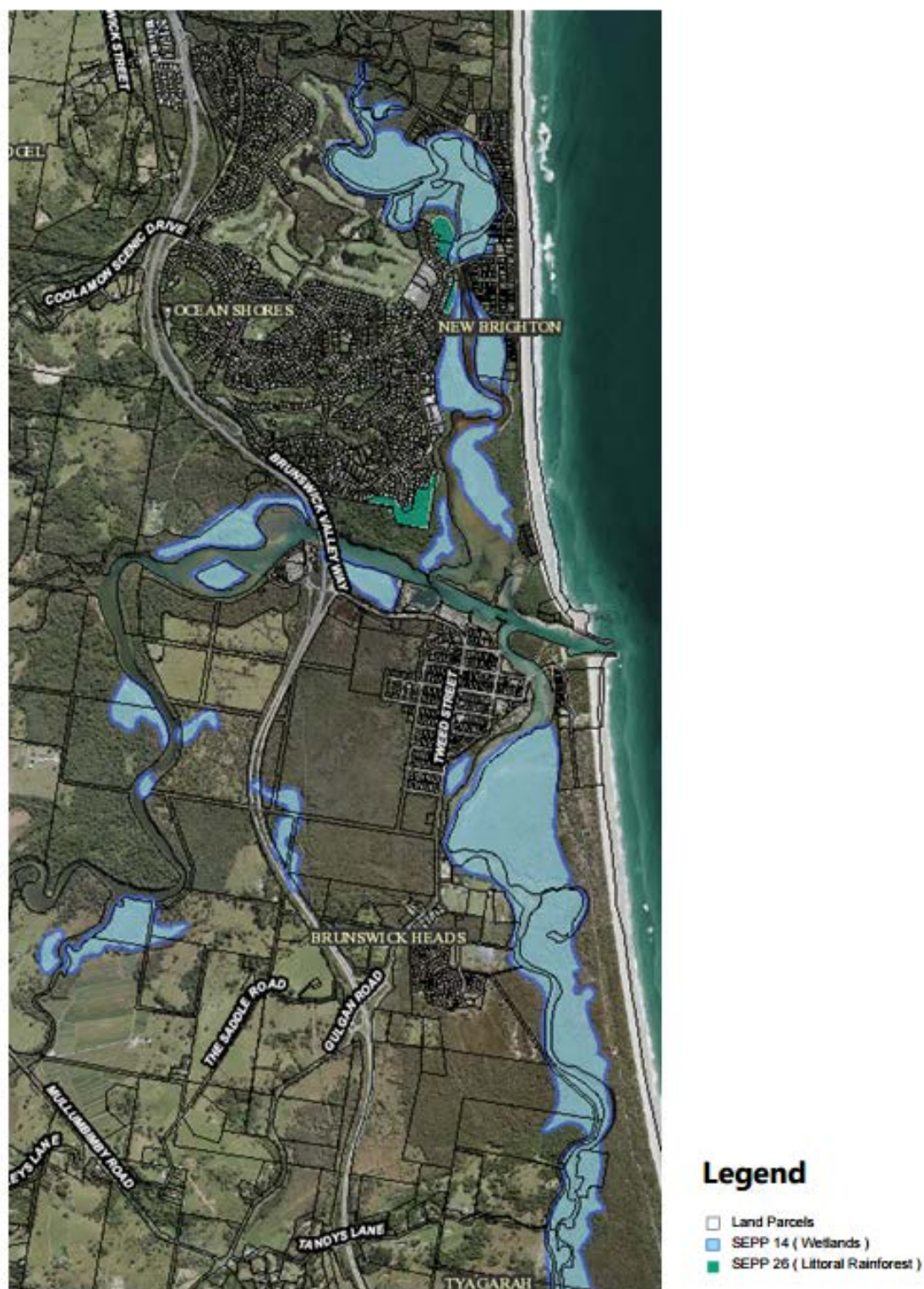


Figure 3-1 – Extent of wetland and littoral rainforest protected by SEPP legislation

3.2 Key Impacts and Activities

The primary human impacts have been the modification of the hydrology and hydrochemistry of the estuary, as well as the degradation and loss of habitat for riparian and estuarine organisms

(MHL, 2002). Critical activities that are having or have had adverse impacts on the estuary include:

- non-point source discharges from urban and rural areas
- point source discharges, such as occur from time to time from WWTWs located along the estuary
- clearing of catchment and riparian vegetation
- urban and rural development
- sewer system overflows
- the draining of wetlands
- dredging
- flood mitigation works
- the construction of canals, jetties and training walls.

Further detail on the impact of human activities on key estuary processes, current uses and climate change can be found in **Appendix D**.

3.3 Management Issues

The identification of the key issues confronting the future management of the estuary is an essential step in developing the CZMP. The key issues identified through the “Brunswick River Estuary Study” (BSC, 2002) were presented to the Committee and a group of key stakeholders through a consultation program during the development of the “Brunswick Estuary Management Study and Plan” (2007). The consultations that lead to the adoption of key issues for the management of the Brunswick Estuary are outlined in **Appendix E**.

The adopted key issues for the Brunswick Estuary are identified in the Brunswick Estuary Management Study and Plan (2007) and are described, in order of rank, in **Table 3-1**. These issues have the potential to compromise the sustainable management of the Brunswick Estuary into the future. During the review and update of the CZMP, these issues were assessed for relevance and significance in the present day, and were deemed just as important in 2017 as they were when identified more than 10 years ago (refer to **Table 3-1**).

Table 3-1 – Adopted key issues for the Brunswick Estuary

Rank	Adopted Key Issue	Description
1	Historical and future development	<p>There are problems associated with past developments, such as encroachment into the riparian buffer zone (e.g., The Terrace Caravan Park) and clearing of vegetation, and concerns regarding future urban expansion and infrastructure development. The Kallaroo Circuit Bund and Capricornia Canal at North Ocean Shores also pose issues associated with poor water quality as a result of low estuarine flushing.</p> <p><u>2017 comment:</u> Issue still relevant and of key importance. Water quality in Capricornia Canal of concern due to limited flushing. The area is highly urbanised with stormwater contributing to decreased water quality through a small drain which connects canal to the main arm of Marshalls Creek. A research project was suggested to be undertaken to investigate the water quality in the canal but has not yet been completed. Currently it is unknown what the quality of water is in the area and how much pollutant and nutrient load flows into Marshalls Creek.</p> <p>Clearing of riparian vegetation is still a concern in the urban areas where landowners have cleared mangroves and/or other vegetation to create grassed areas, built revetment walls and built waterway access platforms.</p>

Rank	Adopted Key Issue	Description
2	Poor water quality	<p>Poor water quality within the estuary is primarily caused by pollutants within agricultural runoff, sewer overflow, stormwater runoff and effluent. The Mullumbimby, Brunswick Heads and Ocean Shores STPs contribute a significant nutrient load to the estuary, particularly during wet weather flows. Pollution from accidental spillage from transport has occurred in the past.</p> <p><u>2017 comment:</u> Issue still relevant and of key importance. Apart from the completion and operation of the new Brunswick Valley STP at Vallances Road and resultant improvements to STP water quality, it is very unlikely that broader issues relating to water quality and impacts on the estuary have changed by any significant measure. Stormwater is still a significant problem contributing to nutrient loads and pollutants from industrial runoff.</p>
3	Foreshore access	<p>Limited foreshore access, particularly adjacent to caravan park camping areas, causes conflicts between users (walkers versus campers). Coupled with this is the lack of connectivity between Crown Reserves.</p> <p><u>2017 comment:</u> Issue still relevant and of key importance. User conflict is a growing issue due to the amount of people undertaking passive recreation within the area. There are also growing numbers of businesses (such as kayak tours) accessing the estuary and competing for space (with potential impacts to seagrass and saltmarsh areas). An emerging and growing issue within the area (and within the Shire as a whole) is illegal camping. As noticed during the vessel based site survey there are numerous places where people camping illegally are trampling on the bank vegetation and causing bank erosion (along with other impacts such as rubbish and untreated effluent).</p>
4	Loss and condition of riparian vegetation and aquatic vegetation	<p>Clearing for development and agriculture has caused a progressive reduction in the extent and condition of riparian vegetation. There is a need for the preservation and rehabilitation of existing riparian vegetation. In particular, the mid- and upper Brunswick Estuary, which has large areas of agricultural rural land, has lost significant areas of riparian vegetation as a result of agricultural clearing practices. Pollution incidents, sedimentation and waterway use are threatening important aquatic habitats such as seagrass beds, mangroves, saltmarsh communities and wetlands. There are particular concerns regarding the loss of seagrass beds in Lower Marshalls Creek.</p> <p><u>2017 comment:</u> Issue still relevant and of key importance. The area of riparian vegetation is considered to have largely unchanged or decreased. There are still large expanses along the Mid to Upper Brunswick River where riparian buffers are missing or are very sparse.</p>
5	Bank erosion	<p>Increased bank erosion, failure of remedial measures and unsightly and unsafe erosion protection measures are particularly evident along the mid-Brunswick River, adjacent to the Rugby Club and the Ferry Reserve Caravan Park. There are significant areas of bank erosion along the mid-Brunswick River. This is coupled with the loss of riparian vegetation in this area.</p> <p><u>2017 comment:</u> Issue still relevant and of key importance. Bank erosion is rife within the Main Arm of the Brunswick River, particularly in the mid to upper Brunswick estuary as outlined in the results from vessel based site survey. There are now bank erosion sites in all reaches of the estuary (Brunswick River, Simpsons Creek and Marshalls Creek). If left unstabilised, areas eroding banks contribute to poor water quality due to increasing turbidity through suspended solids.</p>

3.4 Management Objectives

The primary objective of the CZMP for the Brunswick Estuary is to provide a range of management options or strategies for maintaining and improving estuary condition and function. These options should include measures that will protect the essential features of the estuary (e.g. the primary estuary processes), resolve key issues and improve opportunities for estuary usage. However, prior to developing specific management measures aimed at achieving these goals, it is necessary to identify a set of specific management objectives.

Accordingly, a list of management objectives were identified based on a review of background documents, consultation with the Committee and key stakeholders, and outcomes from land use and estuary use assessments that were carried out as part of the project. The objectives were discussed and prioritised and, from the Committee's perspective, the highest ranked objectives were considered to be the need to:

- improve water quality
- improve estuary ecological health and biodiversity
- conserve Aboriginal and heritage sites
- determine sustainable tourism
- control and manage development.

As an outcome from a Committee workshop held on 29 April 2005, a finalised set of adopted management objectives was confirmed for the estuary. This involved extensive discussion of management issues and resulted in the adopted list of management objectives.

The adopted management objectives were then used to develop strategies and actions for the sustainable management of the estuary and adjoining catchment. These strategies are linked to the key issues identified. The provisional list of potential management strategies was then presented to the Committee in a workshop involving a discussion of the technical reasons for implementing particular strategies and the benefits that would accrue from implementation. The outcome from the workshop was the development of a list of measures and strategies for inclusion within the CZMP.

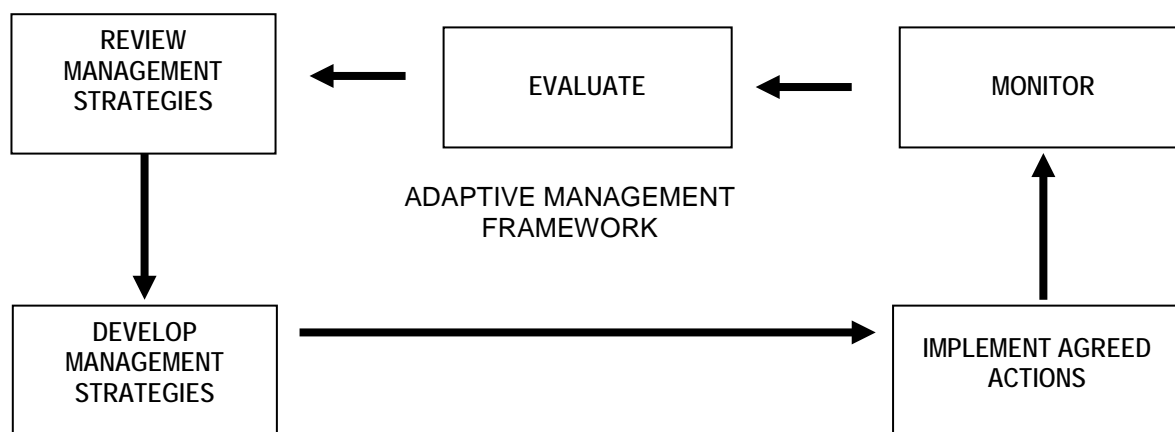
This CZMP does not attempt to address the coastal hazard of tidal inundation at this time. Future reviews of the CZMP may incorporate tidal inundation risk and corresponding management measures.

3.5 Monitoring and Review

The estuary management planning process is consistent with an adaptive management framework. The benefits of such an approach include:

- the assessment of ecosystem health
- evaluation of the success of management programs and adoption of appropriate management responses
- increased scientific understanding of the estuarine ecosystem
- education of the community.

Monitoring and evaluation of the CZMP implementation is critical to the overall success in the estuary management planning process. The main components of the adaptive management framework are represented conceptually in the following diagram.



The CZMP will be monitored as strategies are implemented and projects are executed. Council will aim to conduct an update of the implementation schedule and strategies annually. The CZMP will undertake a comprehensive review within a 5 year time frame prior to 2021 at which time the plan may be transitioned to a CMP. This transition to a CMP is most likely to occur in 2019 as it will require a significant length of time (up to 2 years). The process of transitioning the CZMP to a CMP will involve new community consultation, engagement with stakeholders and identification of management issues, objectives and strategies.

4 Management Strategies

A variety of strategies have been determined to address the management objectives for the estuary. These actions encompass structural and non-structural measures aimed at protecting significant areas and improving aspects of the estuary to make it more suitable for existing and future waterway users. Many of these options were suggested by Committee and community members during the consultation phases of the study.

Where possible, the actions aim to harness the natural attributes of the catchment and are sympathetic to the interests of existing land users. The recommended strategies are presented in the following section under the following categories and have been assigned a category identifier as indicated in the brackets ():

- (1) Planning controls and policies (P)
- (2) Economic incentives and cost-sharing arrangements (C)
- (3) Regulation (R)
- (4) On-ground works - bank erosion, riparian revegetation and public access management (B)
- (5) Investigation and research (IR)
- (6) Monitoring (M)
- (7) Education and public relations (E)

Each strategy has been assigned a priority ranking and time frame for implementation. All strategies are **pending available funding and resources** with priority rankings defined and colour coded as follows:

- **Priority 1** Implementation should proceed within the next seven years and is required to address issues considered to require more attention.
- **Priority 2** Implementation should proceed at some time during the next seven to fifteen years and is required to address issues that can be “lived with” over the medium term.
- **Priority 3** Implementation should proceed at some time in the future (15+ years) and are less urgent, being for the long term benefit of the estuary.

4.1 Planning Controls and Policies

4.1.1 Priority One Strategies

Recommended Strategy	
P1. COUNCIL PLANNERS TO ENSURE FUTURE RESIDENTIAL REZONINGS INCLUDE FORESTED BUFFER ZONES BETWEEN AGRICULTURAL AND NEW RESIDENTIAL LANDS	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Council planners to ensure that future residential rezonings include forested buffer zones between agricultural and new residential lands at: <ul style="list-style-type: none"> – Ann Street, Mullumbimby – Bayside Brunswick – Existing residential-zoned land on Main Arm Road, Mullumbimby – Clays Road / Coral Avenue – Left Bank Road, Mullumbimby. 2. Involve local Landcare groups to create buffers between existing town / agricultural boundaries 3. Investigate the introduction of farm forestry planting incentives for land owners. Planting could be tax deductible if linked to other agricultural production 4. Encourage rural landholders to prepare Property Vegetation Plans with the North Coast Local Land Services <p>Land use conflict is real and needs to be managed now and into the future. Adequate planning is the most successful way to ensure that town and agricultural uses can co-exist. The intention of this Strategy is to reduce the conflicts between agriculture and adjoining landowners through planning for adequate buffers between conflicting uses. Buffers should be required as part of any rezoning of rural land to a residential zone. Property Vegetation Plans and Landcare activities may also be useful tools to achieve buffers between agriculture and the adjoining residential land.</p> <p>Incorporating buffers to manage land use conflicts will remain the primary planning tool when undertaking future residential rezonings. Whether or not these areas are planted out depends on (i) what can be negotiated with the landowner/developer at the time and (ii) having a framework in place for future management of these buffer areas. General riparian planting and habitat corridors are also of great significance and need to be implemented via a co-ordinated approach to minimise land use conflicts and ensure environmental rehabilitation and enhancement.</p> <p>Increasing catchment vegetation will assist in reducing the rate of runoff, improving the quality of catchment runoff as well as filtering the runoff thereby reducing the overall sediment and pollutant load to the estuary.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	Operational
Grant/Funding Options	-
Projected Date for Commencement	Within 7 years
Status	Underway (<25% completion)

Recommended Strategy	
P2. PREPARE THE NORTH BYRON COASTAL CREEKS FLOOD STUDY TO INCORPORATE THE IMPACTS OF CLIMATE CHANGE	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Prepare the North Byron Coastal Creeks Flood Study incorporating modelling of Marshalls, Simpsons and Brunswick Catchments. The study is to consider the areas of Mullumbimby, Brunswick Heads, Ocean Shores, New Brighton and South Golden Beach. 2. Develop a Flood Risk Management Study and Plan for these areas. 3. Incorporate the impacts of climate change into the Flood Risk Management Study and Plan based on Council's adopted climate change parameters. <p>The impacts of climate change are to be incorporated into a Flood Risk Management Study and Plan based on the adoption of climate change parameters outlined in Byron Shire Council's Climate Change Strategic Planning Policy, adopted in 2008 and last updated in 2014.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	\$75,000
Grant/Funding Options	Floodplain Management Grant Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Underway (<25% completion)

4.1.2 Priority Two Strategies

Recommended Strategy	
P3. INCORPORATE ANY REMAINING VACANT FORESHORE CROWN LAND INTO A FORMAL PUBLIC LAND MANAGEMENT REGIME AND PREPARE PLANS OF MANAGEMENT FOR ALL CROWN LANDS WITHIN AN INTEGRATED ESTUARY / FORESHORE RESERVE SYSTEM	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Liaise with the Department of Industry - Lands to identify all Crown Reserves within the Brunswick Estuary that do not have a current Plan of Management 2. Prepare draft Plans of Management within an integrated estuary / foreshore reserve system 3. Undertake community consultation to obtain community feedback on draft Plans of Management 4. Finalise reports. <p>There are a number of Crown Reserves throughout the Brunswick Estuary that do not currently have a Plan of Management. It is important that these are managed in a co-ordinated manner to ensure there are no negative impacts on estuary health and that the Plans of Management provide appropriate space for the proposed access paths in the "Draft Foreshore Access Concept Plan".</p> <p>It is important that the community is involved in the preparation of any plans to ensure that there is community support for their use. The Plans will ensure connectivity of habitats, the regeneration of vegetation and protection of catchment vegetation. This is particularly important for the large area of Crown land upstream of the Ferry Reserve Caravan Park.</p> <p>It is also proposed that surplus funds generated from the Caravan Parks throughout the estuary be expended within the Crown Reserves and adjacent estuary.</p>	
Implementation of Task	
Lead Agency	Department of Industry - Lands
Total Cost Estimate	\$71,500
Grant/Funding Options	Public Reserves Management Fund (Dept. of Industry - Lands)
Projected Date for Commencement	Within 7 - 15 years
Status	Underway (<25% completion)

Recommended Strategy	
P4. PREPARE A WATER-SENSITIVE URBAN DESIGN POLICY FOR THE BYRON SHIRE	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Council to prepare a draft WSUD Policy in consultation with State Agencies, industry and the community 2. Undertake public exhibition of draft policy document 3. Finalise WSUD Policy 4. Council adoption of WSUD policy 5. Developers advised of new policy and provided with fact sheets on key techniques 6. Implementation of WSUD Policy <p>Water Sensitive Urban Design (WSUD) is a design approach that integrates stormwater management with the urban water cycle. Some WSUD techniques include the use of rainwater tanks, water-efficient fixtures, grassed swales replacing kerb and gutter, bio-retention systems, vegetated filter strips to remove pollutants from stormwater flows, riparian zone protection and revegetation.</p> <p>Byron Shire Council has developed Comprehensive Guidelines for Stormwater Management (2014) recommends a number of WSUD type strategies such as rainwater tanks and on-site retention. The plan also recommends that Council policies should be improved to reduce the amount of hard surfaces. A WSUD Policy would formalise these requirements and detail the range of WSUD techniques that can be incorporated into new developments to increase infiltration, reduce the quantity and improve the quality of stormwater runoff.</p> <p>The use of such techniques would greatly reduce the impacts on receiving waters within the Brunswick Estuary. The implementation of such a policy is in line with the NSW Government's Building Sustainability Index (BASIX) requirements.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	\$18,750
Grant/Funding Options	-
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

4.1.3 Priority Three Strategies

Recommended Strategy	
P5. DEVELOP AN ACID SULFATE SOILS MANAGEMENT PLAN FOR THE CATCHMENT	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Undertake a soil survey of the area to the north and south of the Brunswick River, and the Marshalls Creek sub-catchment in accordance with Recommended Strategy IR5 2. Undertake water quality monitoring to determine sites of acid runoff 3. Prepare whole-farm plans for properties on high risk ASS 4. Review and assess Marshalls Creek Floodplain Management Plan to identify areas with high probability for development 5. Develop ASS Management Plan in accordance with the NSW Acid Sulfate Soil Manual 6. Establish ASS demonstration sites, such as at the Kallaroo Circuit Bund / Capricornia Canal area 7. Organise awareness and education activities such as field days, information bulletins and newsletters. <p>There is currently no detailed information on the actual distribution of ASS in the Brunswick estuarine system. The OEH Acid Sulfate Soil Risk Maps are useful for estimating the possible extent of ASS in the area, but are not reliable as a basis for making an ASS Management Plan (ASSMP).</p> <p>There are two other management strategies recommended within the plan implementation strategy that will provide the appropriate level of baseline information required to prepare an ASSMP. The first strategy relates to a drain mapping exercise to be undertaken throughout the estuary, and the second relates to the undertaking of a soil survey throughout the catchment to determine the actual areas of PASS (Potential Acid Sulfate Soils). These two strategies (IR5 and IR6) will need to be addressed prior to the development of the ASSMP.</p> <p>The ASSMP should outline the strategies to manage the potential impacts of development works and catchment activities that are likely to disturb acid sulfate soils. The ASSMP needs to specify all potential environmental impacts, performance criteria, and mitigation strategies, together with relevant monitoring and reporting requirements. Where an undesirable impact or unforeseen level of impact occurs, the appropriate corrective action should be implemented.</p> <p>The plan will:</p> <ul style="list-style-type: none"> – reduce the risk of disturbance of PASS – reduce acid runoff to the estuary and resultant fish kills – provide guidance and support for best practice agricultural activities – improve understanding of the basic principles of acidification. 	
Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	\$60,000
Grant/Funding Options	Floodplain Management Grant Program (OEH)
Projected Date for Commencement	Within 15+ years
Status	Not started (0% completion)

4.2 Economic Incentives

4.2.1 Priority Two Strategies

Recommended Strategy	
C1. INTRODUCE A COMMUNITY ENVIRONMENTAL GRANTS SCHEME	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Investigate and determine the possibility of introducing an Environmental Grants Scheme similar in nature to Tweed Shire Council – River Health Grants 2. Secure initial funding for start-up of scheme 3. Establish continued funding and potential long-term funding options. 4. Introduce grants scheme to community. 5. Publish media article advising rural land owners of Environmental Grants Scheme and how to apply 6. Implement Environmental Grants Scheme through the BSC website. <p>For many landowners start-up costs for on-ground works is the hardest step and the limiting factor in initiating environmental works. It would be advantageous if Council could more actively encourage on-ground works by landowners through the establishment of an Environmental Grants Scheme. Tweed Shire Council has grants for works in areas adjacent the river bank that will lead to improvements in water quality and stream health. Grants are available for work such as stock fencing, erosion control, revegetation and weed management.</p> <p>Council would ultimately act as a funding body for administering the grants with assistance from local Landcare groups who would provide educational support to applicants.</p> <p>Community recognition of individuals who undertake use of the grants scheme by employing environmentally responsible practices on their property may include an annual awards ceremony facilitated by the Council and/or recognition on the website.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	\$12,000
Grant/Funding Options	Environmental Trust (OEH); Small Grants for Rural Communities
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

4.3 Regulation

4.3.1 Priority One Strategies

Recommended Strategy	
R1. LOBBY FOR REVIEW OF SPEED LIMITS WITHIN THE BRUNSWICK RIVER AND MARSHALLS CREEK	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Council and Marine Parks to lobby Roads and Maritime Services to review speed limits within the Lower Brunswick Estuary. 2. Prepare community information brochures on new speed restriction zones. 3. Prepare media release advising of new speed restriction zones. 4. Install signs in prominent foreshore locations clearly specifying new speed restrictions. <p>The Brunswick River attracts significant numbers of recreational boats, particularly during peak tourist seasons. The estuary is popular for swimming, snorkelling, beach going and other passive recreational uses. However, it is also popular for motorised boating, passive and unpowered watercraft use (e.g. Stand Up Paddle Boards) and recreational fishing.</p> <p>There are currently no speed restrictions on the lower Brunswick River as far upstream as the confluence with Kings Creek. There are some restrictions in Simpsons Creek downstream from the footbridge. There are a significant number of passive recreational uses being undertaken in the lower reaches of the river (especially in Marshalls Creek and between Marshalls Creek and Torakina Beach) In addition to the potential for user conflicts, there is a significant collision risk in the high use lower reaches of the estuary. It is not uncommon to see in the high use lower reaches of the estuary. It is not uncommon to see boats speeding past snorkelers, paddle boarders, or swimmers at close proximity and this risk needs to be addressed.</p> <p>It is recommended that the speed limits for the lower Brunswick River be reviewed. This strategy is in accordance with the Marine Parks Operational Plan of Management for the Cape Byron Marine Park (MPA, 2004b) which endorses that speed limits should be reviewed in consultation with NSW Roads and Maritime Services. A review of boat speeds should also consider boat wake and its contribution to riverbank erosion, such that any speed reduction should also aim to minimise the impact of boat wake on riverbanks and estuarine ecology.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council and Department of Primary Industries - Marine Parks
Total Cost Estimate	Operational
Grant/Funding Options	-
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy	
R2. INVESTIGATE AND ENFORCE POTENTIAL ILLEGAL ROCK ARMOURING WITHIN THE BRUNSWICK ESTUARY	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. DPI – Fisheries to investigate and enforce sites of potential illegal rock armouring (Sites SI01, MA01, MA06, BR06, BR09, BR11, BR12 and BR17) 2. DPI - Fisheries to liaise with Byron Shire Council and review development approvals documentation to determine whether ad-hoc rock armouring has appropriate Council and Department of Primary Industries - Fisheries approval 3. Undertake enforcement action where appropriate 4. Encourage land owners to undertake recommended bank stabilisation options <p>Illegal ad-hoc rock armouring is still prolific along the banks of the Brunswick River, however, many of the areas have been stabilised by the rocks in areas where riparian vegetation is lacking. If rock armouring is to be removed then it may be necessary to undertake revegetation works in parallel with removal. Department of Primary Industries – Fisheries is responsible for compliance actions on any unauthorised rock armouring and enforcement action should be undertaken by DPI - Fisheries where appropriate. Landowners should also be educated and encouraged to undertake best practice river bank and riparian restoration works, such as increasing riparian vegetation and restricting cattle access to river banks (<i>Refer - Management Strategies G3 and E2</i>).</p>	
Implementation of Task	
Lead Agency	Department of Primary Industries – Fisheries and Byron Shire Council
Total Cost Estimate	Operational
Grant/Funding Options	-
Projected Date for Commencement	Within 7 years
Status	Progressing (25% - 75% completion)

Recommended Strategy

R3. INVESTIGATE AND UNDERTAKE COMPLIANCE ACTION ON ILLEGAL CAMPING ALONG ALL REACHES OF THE BRUNSWICK ESTUARY

Description of Task

Actions required:

1. Byron Shire Council and Department of Industry – Lands to investigate and undertake compliance action on illegal camping along all reaches of the Brunswick Estuary
2. Undertake enforcement action where appropriate
3. Encourage land owners to limit illegal camping by fencing off areas, or advising regulatory authorities when illegal camping is observed.

During the Site Survey (*Refer - Appendix B*), it was apparent that access to the waterway and riverbank in some areas was unrestricted even though the areas were private property, Council or Crown Land. Illegal overnight camping was evident along Simpsons Creek (Sites SI03 and SI04) and the Brunswick River (Site BR17) where areas of riparian vegetation have been damaged by trampling and vehicle access.

Potential impacts of camping in undesignated areas include:

- Trampling and removal of riparian vegetation
- Creation of erosion areas of river bank
- Rubbish pollution of waterways
- Effluent pollution of waterways
- Potential unsocial behaviour and impediment of areas for general public day-use.



Implementation of Task

Lead Agency	Byron Shire Council and the Department of Industry - Lands
Total Cost Estimate	Operational
Grant/Funding Options	-
Projected Date for Commencement	Within 7 years
Status	Underway (25% completion)

Recommended Strategy	
R4. INVESTIGATE AND ENFORCE ENCROACHMENT OF BUILT STRUCTURES AND CLEARING OF RIPARIAN VEGETATION AT AREAS ADJACENT BRUNSWICK ESTUARY	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Byron Shire Council and Department of Primary Industries - Fisheries to investigate illegal landowner development (built structures) and riparian vegetation clearing along all reaches of the Brunswick Estuary 2. Undertake enforcement action (where appropriate) 3. Landowners to remove structures and restore riparian vegetation buffer (where appropriate) <p>There are various instances of riparian vegetation clearing, installation of private revetment works and construction of in-stream water access structures adjacent reaches of the Brunswick Estuary (specifically at Sites SI01, MA01 and MA06). At Site MA01, Marshalls Creek floating pontoons and concrete formwork are present at most properties. In some instances these structures may be approved by Council, however, many may not and an investigation of Development Approvals is required.</p> <p>This management strategy should be undertaken in parallel with <i>Recommended Strategy E3</i> to raise awareness through a community education program advising the value of the estuary, riparian vegetation and the impact of human activities on estuary processes.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council; Department of Primary Industries - Fisheries
Total Cost Estimate	Operational
Grant/Funding Options	-
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

4.4 On-Ground Works – riverbank stabilisation, revegetation and repair

Riverbank stabilisation can be achieved by implementing a number of approaches varying from structural protection through to non-structural adaptive land use planning controls, including:

- ◆ Construction of protective works
 - hard structural options
 - soft structural options
 - combined hard and soft options
- ◆ Non-structural options
 - improved catchment management
 - adaptive hazard management.

The appropriateness of a particular management measure depends to a large extent on the level of existing development likely to be affected and the financial resources of the community. For instance, a threatened area characterised by intense urban use and substantial infrastructure may require heavy bank protection, whereas rural areas may approach the issue with a much larger range of management options. Whatever the case, the CZMP should be flexible and allow for conditions to be varied subject to monitoring of the hazard.

Note: It is acknowledged that a large section of the Brunswick Estuary is the subject of a Native Title Claim by the Arakwal People and engagement with the Bundjalung of Byron Bay Aboriginal Corporation (Arakwal) should be undertaken throughout the implementation of the CZMP. A cultural assessment may be required for any proposed works on riverbanks and areas of significance.

Hard Structural Options

Hard structural alternatives are primarily applied to banks requiring significant stabilisation and erosion protection. A physical barrier is constructed on the riverbank to absorb the erosive energies of the river and physically hold back the toe or slope of the bank.

If properly designed, many of the “hard” structures catalogued below can potentially eliminate erosion problems along the protected area. However, they can also alter the hydrodynamics of the river and thus modify patterns of erosion and accretion along its banks. This is especially true immediately downstream of the structure, where increased flow and sediment load due to the works can exacerbate already present erosion problems or in fact create new ones.

From a design perspective, structural protection must be able to cater for the application of surcharge loads and the dissipation of pore pressure, as well as protecting the bankline from surface and toe erosion. Similarly, erosion at the ends of structural protection (outflanking) is a common failure mode and must be guarded against.

In addition to downstream problems, the potential negatives in an area proposed for hard structure stabilisation are numerous, including structure failure due to unexpected toe scour, loss of aesthetics, reduction in the amount of viable habitat and often the high cost of construction and maintenance.

In particular, any major change to the river bank could have a significant affect on the local terrestrial and aquatic habitats, and may inhibit future vegetation development. The riparian habitat is an important interface between the aquatic and terrestrial environments, and its establishment and development should be encouraged.

Hard structural modifications to a river bank would require a permit under the Fisheries Management Act, 1994. All factors needs to be carefully examined when weighing the costs and benefits of any proposed hard structural option. Hard structural bank stabilisation options and comparative costs for each option over typical river bank heights (~5 metres) are shown below in **Table 4-1**.

Table 4-1 – Approximate cost ranges for 'hard' bank stabilisation options

Option	Description of Hard Structural Options	Min Cost (\$/m)	Max Cost (\$/m)
A	Rock revetment with buried toe apron	1875	2500
B	Rock revetment with self launching toe apron	1500	2250
C	Gabion wall on a reno mattress toe apron	3125	4375
D	Masonry or block wall	1875	3125
E	Structural membrane	1875	2500
F	Revetment reconstruction with existing materials and a new underlayer / geotextile	1000	1500
G	Top-up of existing revetment with additional rock material and bank regrading	375	625
H	Rock supported toe and bank regrading	1250	1875
I	Localised rock protection and anchoring of valuable trees or vegetation	10000	12500

A detailed description of a range of hard structural bank stabilisation options, including their advantages and disadvantages is provided in Appendix F.

Soft Structural Options

Soft structural alternatives may also be employed for erosion protection, but can be additionally targeted at foreshore enhancement for flora and fauna and for recreational access, particularly where there is the opportunity to combine bank protection with foreshore landscaping / habitat enhancement. They can be extremely useful in areas where erosion problems exist at or above the waterline, though these methods will not generally aid in the prevention of deep seated bank failures.

However, methods such as regrading combined with revegetation can significantly improve the stabilisation of existing steep and unstable banks.

Vegetation, in particular, can play a significant role in bank stabilisation. The binding root systems of riparian vegetation act to prevent soil erosion from river banks by increasing bank strength. Vegetation also lowers natural groundwater levels, and thus reduces the susceptibility of banks to seepage failures. Surface runoff can be intercepted and slowed by vegetation and its associated natural debris. This acts to dissipate the energy of the flow, allowing sediments to be deposited before entering the waterway.

Soft structural bank protection options and comparative costs for each option for typical river bank heights are shown in **Table 4-2**.

Table 4-2 – Approximate cost ranges for 'soft' bank stabilisation options

Option	Description of Soft Structural Options	Min Cost \$	Max Cost \$
J	Cutting of trees and roots along riverbank	250 each	2500 each*
K	Large organic debris or trees	1500/tree	2500/tree**
L	Gravel or cobble fillet on berm	125/metre	250/metre
M	Gravel or cobble fillet behind a rock toe	250/metre	750/metre

Option	Description of Soft Structural Options	Min Cost \$	Max Cost \$
N	Mangrove planting behind a rock toe	250/metre	375/metre
O	Mangrove planting behind a wave wall	375/metre	625/metre
P	Vegetation in riparian corridor	10/tree	62.5/tree
Q	Regrading of riverbank	25/metre	250/metre***
R	Creation of sandy beaches	1250/metre	1875/metre****
S	Coir logs (incl. erosion control matting and tubestock sedge planting)	-	100 /metre ²
T	Timber groynes (piles) – costs vary dependant on size required	10/metre	100/metre
U	Formalisation of public access (recycled plastic stairs)	1500/metre	2000/metre

*Depending on size and accessibility

**May be obtained for minimal cost from clearing projects (such as highway upgrade)

***Plus revegetation required

****Typically \$75,000 to \$120,000 each beach

The costs presented are indicative only and are likely to vary on a site by site basis subject to the design requirements, availability of materials, and ease of construction.

A detailed description of a range of soft structural bank stabilisation options, including their advantages and disadvantages, can be found in F.

Cost Estimates

The costs presented in this CZMP are indicative only, based on a per metre or per tree basis. The costs have not been presented on a per site basis, as detailed surveys of each site have not been completed and size is unknown. The estimates derive from the Brunswick Estuary Management Study and Plan (2007) and are based on Patterson Britton & Partner's experience and judgement as a firm of practising professional engineers familiar with the construction industry. The estimates comprise material costs, labour and machinery costs, however, do not include items such as design fees, project management fees, authority approval fees, contractors risk and project contingencies (e.g. to account for construction and site conditions, weather conditions, ground conditions and unknown services).

The construction cost estimate by Patterson Britton & Partners is not to be relied upon in any way. If a reliable cost estimate is required, then an appropriately qualified Quantity Surveyor should be engaged.

The original estimates from 2007 have been increased by 25% to account for an approximate average annual inflation rate of 2.5% over 10 years.

Combined Soft and Hard Stabilisation Options

A combination of hard and soft options can be an effective and aesthetic way to provide erosion protection. It provides the instant fix of hard structural works whilst allowing vegetation integral to river health and function to establish and improve long-term bank stability.

In general, there are two primary configurations for these combinations:

- hard structural options below normal water levels and soft options along the upper banks
- hard structural options on entire bank, through which vegetation can grow

With the former, the hard structure acts as a foundation upon or behind which bank regrading and/or revegetation can be undertaken. The latter provides a stable matrix for the direct planting of vegetation.

Appendix F provides a detailed description, including conceptual designs for each of the recommended bank stabilisation options. These options may be used in isolation or in combination to provide a stable bank.

Figure 4-1 to Figure 4-4 present the results of the Site Survey undertaken in January 2017 of the Brunswick River, Simpsons Creek and Marshalls Creek. The Site Survey has identified many new sites within the estuary that require on-ground works comprising bank stabilisation (hard, soft or combination), revegetation of the riparian buffer zone, or repair of existing structures (such as revetment walls). The 2005 site survey of the river found no reported bank erosion sites in Marshalls Creek, in comparison to 2017 site survey which found 7 sites requiring some kind of on-ground work (bank stabilisation, repair or riparian revegetation) in order to improve the ecological condition and stability of the riparian zone and estuarine waters.



Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no warranty is given that the information contained on this map is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of the information prior to using it. Note: The information shown on this map is a copyright of the Byron Shire Council and the NSW Department of Lands.

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1:11,048 @ A1 size

Marshalls Creek - Sites Identified for On-Ground Works



Date: 18/04/2017

Figure 4-1 – Sites identified for on-ground works, Marshalls Creek

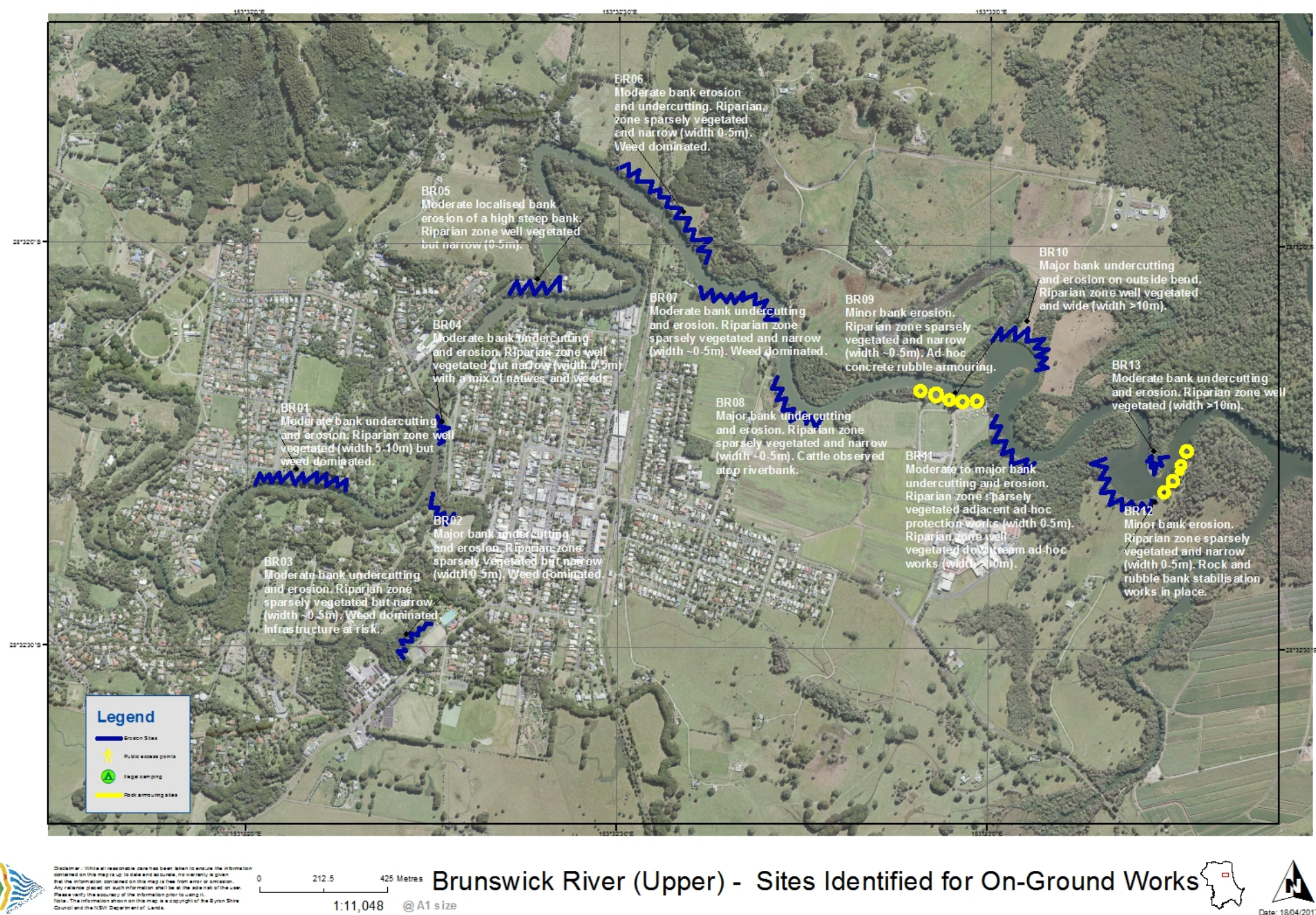


Figure 4-2 – Sites identified for on-ground works, Brunswick River (Upper Catchment)

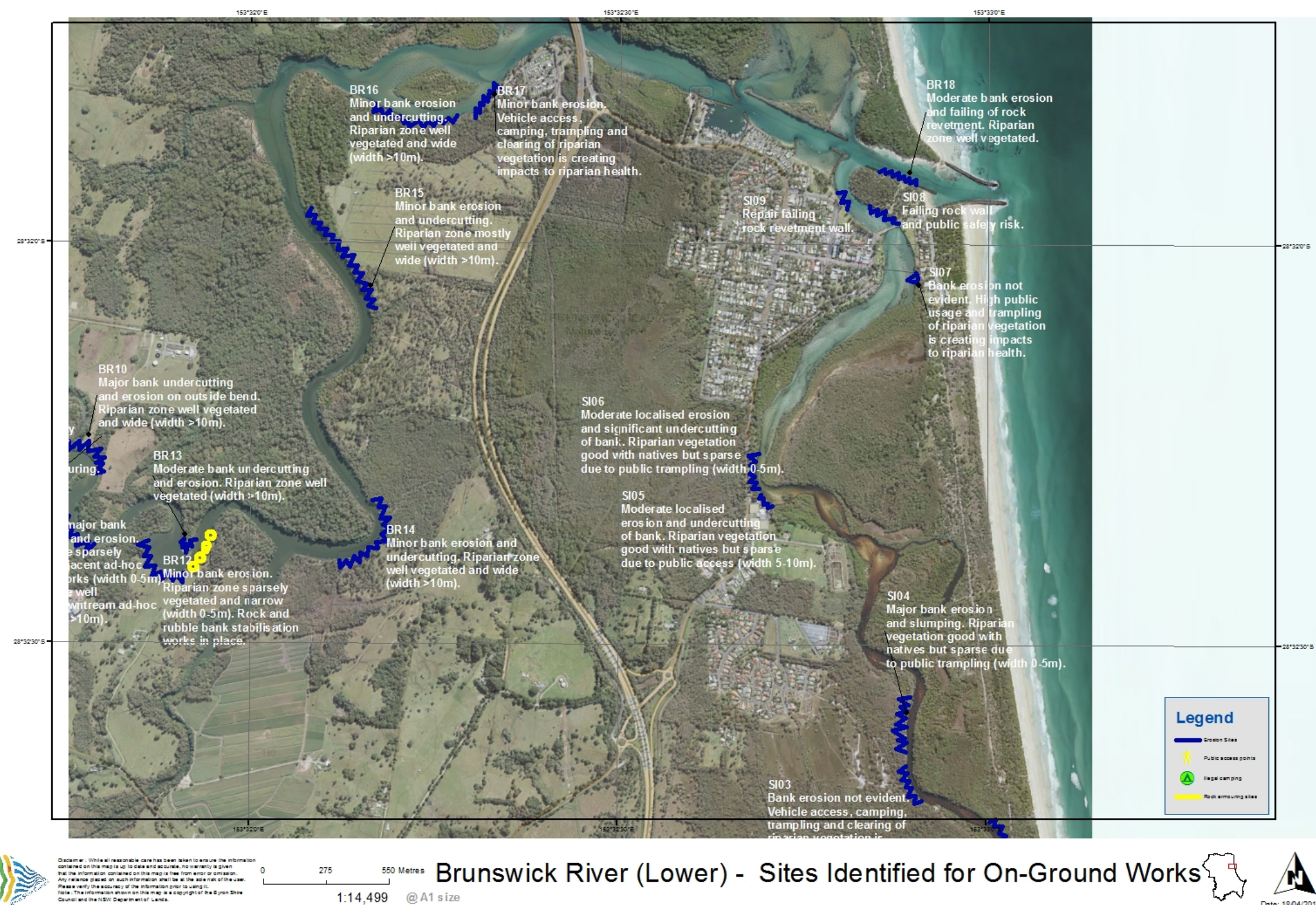
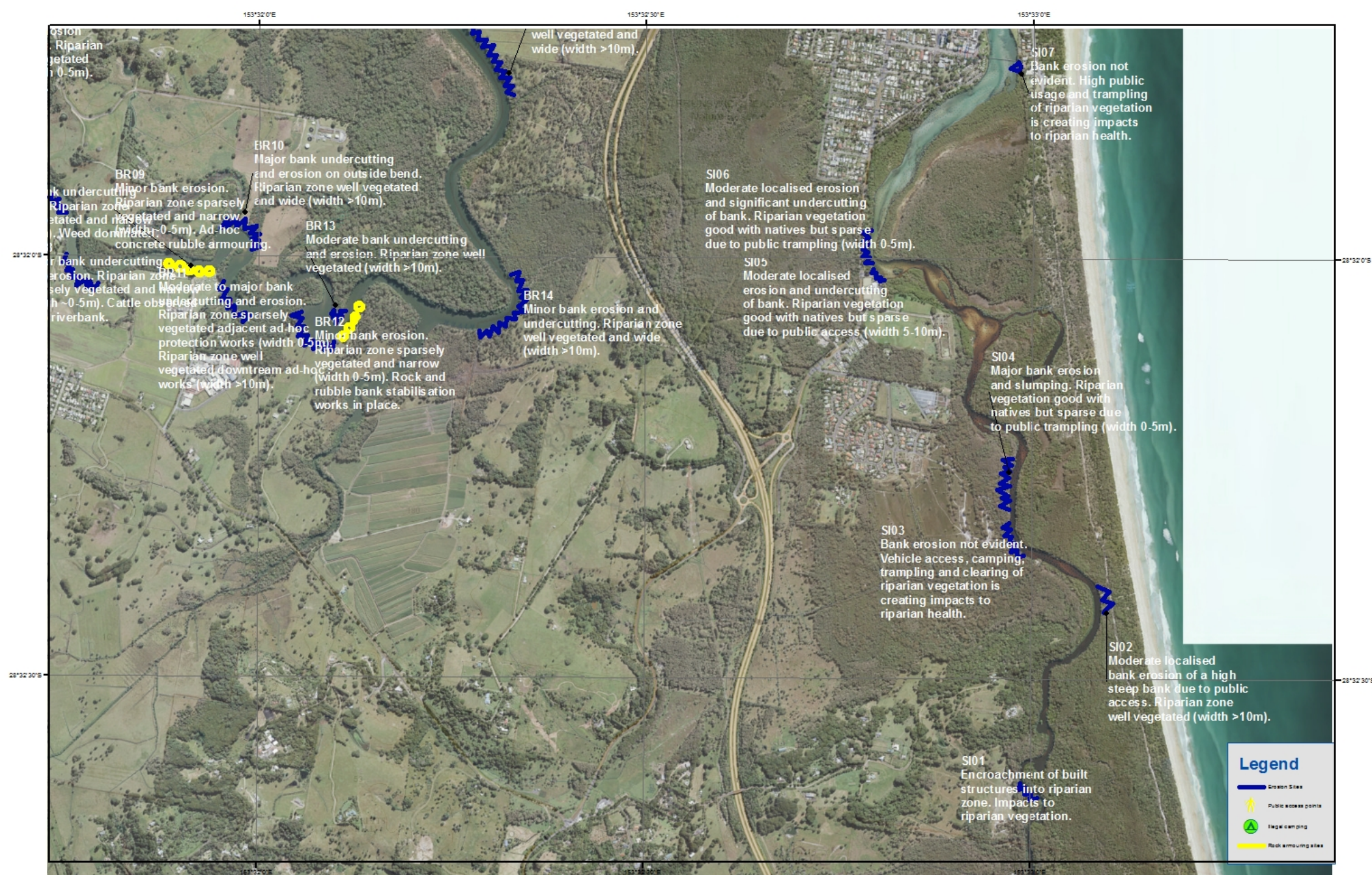


Figure 4-3 – Sites identified for on-ground works, Brunswick River (Lower Catchment)



Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no warranty is given that the information contained on this map is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of the information prior to using it. Note: The information shown on this map is a copyright of the Byron Shire Council and the NSW Department of Lands.

0 310 620 Metres
1:16,061 @ A1 size

Simpsons Creek - Sites Identified for On-Ground Works



Date: 30/05/2017

Figure 4-4 – Sites identified for on-ground works, Simpsons Creek

4.4.1 Priority One Strategies

Recommended Strategy

B1. UNDERTAKE ON-GROUND WORKS (REVEGETATION) AT SITES SI03 AND SI04, SIMPSONS CREEK AND SITE BR17, BRUNSWICK RIVER

Description of Task

Actions required:

1. Engage landowner to determine willingness to participate
2. Formalise or restrict public access in consultation with landowner and key stakeholders
3. Compliance action on illegal camping (*Refer - Recommended Strategy R3*).
4. Undertake revegetation works to increase riparian vegetation buffer.

At site SI03 the riparian vegetation has been damaged by camping, human use and vehicle access. The riverbank is stable at present with bank erosion not evident, however, the riparian buffer zone is sparsely vegetated and narrow. Trampling of vegetation and rubbish is the primary issue of the site, and compliance enforcement of camping is the primary management response required.



Photo – Site SI03 showing campers and cleared riparian vegetation

The primary cause of erosion at site SI04 is the lack of riparian vegetation caused by uncontrolled public access. Illegal camping is evident at this site with camping structures in the vegetation and stairs installed down the riverbank. The area is a private property, however, access is not controlled. The ad-hoc public access has caused significant active erosion and slumping of the relatively high and steep riverbank. This has significantly compromised the ecological integrity and bank stability of the site.

Recommended management measures at this site include compliance enforcement of illegal camping and management of public access and riparian revegetation. Formalising public access (or restricting it) at this site will allow the riparian vegetation to rehabilitate thus helping to restabilise the eroding river bank. Bioengineered bank stabilisation works (such as coir logs) may also be appropriate to stabilise eroding bank toe until the native vegetation re-establishes.



Photo – Site SI04 showing camping structures

Site BR17 is just up from Riverside Crescent and is a heavily used general public access area for deployment of watercraft and illegal overnight camping. The site has some localised minor bank erosion and bank under-cutting with ad hoc protection works present. Vehicle access, camping, trampling and clearing of riparian vegetation is creating impacts to riparian health.



Photos – Site BR17

Potential options are illustrated below.

Option	Description	Indicative Cost (\$)
P	Vegetation in riparian corridor	\$10 - \$62.50 per tree
S	Coir logs (incl. erosion control matting and tubestock sedge planting)	\$100 per square metre
U	Formalisation of public access (recycled plastic stairs)	\$2000 per metre

Implementation of Task

Lead Agency	Byron Shire Council and Department of Industry – Lands
Total Cost Estimate	Dependent on size of area to be revegetated.
Grant/Funding Options	NSW Environmental Trust; NSW Coastal and Estuary Grants Program
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

B2. UNDERTAKE ON-GROUND WORKS (STRUCTURAL BANK STABILISATION, FORMALISATION OF PUBLIC ACCESS AND REVEGETATION) AT SITES SI05 AND SI06, SIMPSONS CREEK

Description of Task

Actions required:

1. Develop precinct plan, concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works
4. Undertake revegetation works to increase riparian vegetation buffer.

Site SI05 is directly adjacent the Brunswick Heads Bowling Club and is a heavily used public access area with a rope swing into the river from the large Eucalypt tree. There is public access induced localised erosion and natural undercutting along the river bank into the coffee rock. The site is adjacent the main road and cars use the off-road area to park for access to the creek. The area has good native vegetation including established large trees, however, the access to the river needs to be formalised to prevent further erosion and trampling of riparian vegetation. The large gum tree is stabilising a large part of the river bank in this area and if erosion and undercutting continues it could be lost, thereby threatening the existing public walkway.



Photos - Site SI05 with rope swing and mangroves upstream and downstream

Site SI06 is an existing site of the previous CZMP (Issue No. 4, 2012) and management of this site still remains. There is ad-hoc public access at this site which impacts riparian vegetation and is causing undercutting of the riverbank. The site is adjacent the main road and cars use off-road area to park for access to the creek. The erosion at this location is impacting an Aboriginal midden present within the riverbank and is threatening the existing public cycleway / footpath that runs adjacent to the watercourse. The riparian vegetation is predominantly native, however, sparse due to trampling by public. Mangroves are present upstream and downstream of the area and there a few mangroves trying to establish in the footprint area.

It is therefore a high priority to ensure that the ad-hoc public access, active erosion and undercutting

does not continue. Due to the proximity of site SI05 and site SI06, development of a Precinct Plan is recommended in order to design the most appropriate combination of bank stabilisation works, formalisation of public access, bollarding of the car park area and planting of the riparian buffer zone. It is a large area and heavily used by the community for deploying watercraft, therefore, community consultation is essential.

Site SI06 forms part of the Simpsons Creek Reserve and management actions are outlined in the Brunswick Heads Foreshore Reserves Plan of Management at Brunswick Heads adopted by the NSW Crown Holiday Parks Trust in 2008. Specific actions applicable to this site include:

1. Restore damage to the banks of Simpsons Creek Foreshore
2. Consider creation of a specific location for kayak / canoe launching
3. Maintain the existing pedestrian pathway and improve signposting
4. Restrict vehicular access in areas where there is potential to cause damage to natural features



Photos - Site SI06 showing public cycleway and trampled access.

Potential options are illustrated below.

Option	Description	Indicative Cost (\$)
K	Large organic debris or trees	\$1500 - \$2500 per tree
P	Vegetation in riparian corridor	\$10 - \$62.50 per tree
C	Gabion wall on reno mattress toe apron	\$3125 - \$4375 per metre
A	Rock revetment with buried toe apron	\$1875 - \$2500 per metre
U	Formalisation of public access	\$ 1500 - \$ 2000 per metre

Implementation of Task

Lead Agency	NSW Crown Holiday Parks Trust; Byron Shire Council; Department of Industry – Lands
Total Cost Estimate	Dependent on option
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEI)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

B3. REPAIR BANK STABILISATION WORKS AT SITE SI08 AND SI09, SIMPSONS CREEK

Description of Task

Actions required:

1. Develop concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works.

Site SI08 is on the right bank of Simpsons Creek downstream of the road bridge where the existing rock wall is failing and in need of repair as it creates a public safety risk. Rocks are unstable and the exposed bank is slippery and prone to failure in places. This is a high public usage site where swimming and day-use activities occur all year round. The length of the wall in need of repair is potentially up to 200m.



Photo – SI08 failing rock wall

Site SI09 is on the left hand side of Simpsons Creek directly opposite site SI08. The rock retaining wall is downstream of the Pirate Ship and has rotated to over vertical in places. Section of the wall may be at risk of collapse. This area is heavily used by the general public, and people often sit atop the wall unaware of the potential dangers.

SI09 presents a public safety risk and amenity issue and if left unchecked, may collapse in the near future creating a significant risk to public safety.



Photo - Si09 failing rock wall

Potential options for repair of the wall at this location are presented below.

Option	Description	Indicative Cost (\$)
D	Masonry or block wall	\$1875 - \$3,125 per metre
F	Revetment reconstruction with existing materials and a new underlayer / geotextile	\$1000 - \$1500 per metre
G	Top-up of existing revetment with additional rock material and bank regrading	\$475 - \$625 per metre

Implementation of Task

Lead Agency	Department of Industry - Lands
Total Cost Estimate	Dependent on option
Grant/Funding Options	NSW Environmental Trust
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

B4. UNDERTAKE ON-GROUND WORKS (STRUCTURAL BANK STABILISATION AND REVEGETATION) AT MA04 (CASSONS LANE), MARSHALLS CREEK

Description of Task

Actions required:

1. Develop Precinct Plan, concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works
4. Undertake revegetation works to increase riparian vegetation buffer.

This site has active erosion and significant undercutting of the river bank with the public road at risk. There are significant ad-hoc public access issues and zero riparian buffer in areas. The site in question is a large precinct from encompassing Cassons Lane to the Yum Yum Tree café. There are a lot of ad hoc bank stabilisation works present and no formal access points to the creek. The area is also at risk of tidal inundation hazard and bank erosion hazard to public assets. Due to the large precinct in need of works, development of a Precinct Plan is recommended in order to design the most appropriate combination of bank stabilisation works, formalisation of public access and planting of the riparian buffer zone. It is a large area and heavily used by the New Brighton community for deploying watercraft, therefore, community consultation is essential.

At the time of updating this CZMP, Brunswick Valley Landcare was successful in obtaining funding for some erosion control using coir logs, plantings and bush regeneration. This funding and project will enhance the area in question, and may reduce erosion in some areas, however, is unlikely to remove the necessity for hard bank stabilisation works in certain locations of the precinct.





Potential options are illustrated below.

Option	Description	Indicative Cost (\$)
A	Rock revetment with buried toe apron	\$1875 - \$2,500 per metre
B	Rock revetment with self launching toe apron	\$1500 - \$2,250 per metre
P	Vegetation in riparian corridor	\$10 - \$62.50 per tree
S	Coir logs (incl. erosion control matting and tubestock sedge planting)	\$100 per metre ²

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on option
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

B5. REPAIR BANK STABILISATION WORKS AT SITE MA05, MARSHALLS CREEK

Description of Task

Actions required:

1. Develop concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works.

This site is adjacent the main public road and thoroughfare (River Rd) into New Brighton where some areas of the existing bank stabilisation works have collapsed and need to be repaired. There is also limited riparian vegetation buffer due to the road in such close proximity. Rock works needs to be extended and constructed to the top height of the bank on level with the road.



Potential options are presented below.

Option	Description	Indicative Cost (\$)
G	Top-up of existing revetment with additional rock material and bank regrading	\$375 - \$625 per metre
F	Revetment reconstruction with existing materials and a new underlayer / geotextile	\$1000 - \$1500 per metre
P	Vegetation in riparian corridor	\$10 - \$62.50 per tree

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on options
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

B6. REPAIR BANK STABILISATION WORKS AT SITE MA07, MARSHALLS CREEK

Description of Task

Actions required:

1. Develop concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works.

This site is similar to Site MA05 adjacent the main public road (River Rd), however, this section of the public road is gravel and to the south of New Brighton town in leading into the Public Reserve. Therefore, this road is not the main thoroughfare in an out of town and as such not as heavily used by the community. There is localised erosion and undercutting of the bank, with failing of the rock revetment wall up to 50 m in length.



Potential options are presented below.

Option	Description	Indicative Cost (\$)
G	Top-up of existing revetment with additional rock material and bank regrading	\$375 - \$625 per metre
F	Revetment reconstruction with existing materials and a new underlayer / geotextile	\$1000 - \$1500 per metre
P	Vegetation in riparian corridor	\$10 - \$62.50 per tree

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on options
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

B7. UNDERTAKE ON-GROUND WORKS (STRUCTURAL BANK STABILISATION AND REVEGETATION) AT BR03, MULLUMBIMBY CREEK

Description of Task

Actions required:

1. Develop concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works
4. Undertake revegetation works to increase riparian vegetation buffer.

At this site the creek bank is only stabilised by weeds which could give way in a high flow event. There is no established native vegetation and the eroding bank is extremely close to the boundary of public assets – Council Swimming Pool and Mullumbimby Ex-Services Bowling Club. The built assets are at risk if erosion continues or worsens.



Potential options are illustrated below.

Option	Description	Indicative Cost (\$)
A	Rock revetment with buried toe apron	\$1875 - \$2500 per metre
B	Rock revetment with self launching toe apron	\$1500 - \$2250 per metre
H	Rock supported toe and bank regrading	\$1250 - \$1875 per metre
P	Vegetation in riparian corridor	\$10 - \$62.50 per tree

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on option
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

B8. UNDERTAKE ON-GROUND WORKS (STRUCTURAL BANK STABILISATION AND REVEGETATION) AT SITE BR08, BRUNSWICK RIVER

Description of Task

Actions required:

1. Engage landowner to determine willingness to participate
2. Develop concept designs and costing's
3. Prepare detailed designs
4. Undertake bank stabilisation works
5. Undertake revegetation works to increase riparian vegetation buffer.

This site is an existing site of the previous CZMP (Issue No. 4, 2012) and management of this site is still unresolved and the issue remains. This site has major bank undercutting and erosion and a narrow and sparse riparian vegetation buffer. The primary cause of erosion at site BR08 is channel meander migration, accelerated by the lack of riparian vegetation and possibly wave action from the wind and boats. This has resulted in a relatively high and steep exposed bank. The adjacent sugar cane crop is potentially under threat in the longer term. This site has a good intertidal bench for construction of rock and large woody debris (LWD), gravel/cobble fillets or rock revetment. Establishment of a wide riparian buffer, replanted with native riparian vegetation should be accompanied with restricting cattle from accessing the riverbank.





Potential options are presented below.

Option	Description	Indicative Cost (\$)
H	Rock supported toe and bank regrading	\$ 1250 - \$1875 per metre
K	Large organic debris or trees	\$ 1500 per tree
L	Gravel or cobble fillet on berm	\$ 125 - \$250 per metre
P	Vegetation in riparian corridor	\$10 - \$62.50 per tree
Q	Regrading of riverbank	\$25 - \$250 per metre

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on options
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

B9. UNDERTAKE ON-GROUND WORKS (STRUCTURAL BANK STABILISATION AND REVEGETATION) AT BR10 (BRUNSWICK VALLEY STP, VALLANCES RD), BRUNSWICK RIVER

Description of Task

Actions required:

1. Develop concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works.

Bank stabilisation works were completed at this site (adjacent the Brunswick Valley, Vallances Rd STP), however, the previous rock protection works have failed and slumped into the river. It would appear the design of these rock works was inappropriate for the location being the outside bend of a river. Re-stabilisation by means of an alternative method should be considered as part of the design process. Management of this site is considered a high priority for action due to the extensive and continuous erosion of the riverbank.



Potential options are illustrated below.

Option	Description	Indicative Cost (\$)
F	Revetment reconstruction with existing materials and a new underlayer / geotextile	\$1000 - \$1500 per metre
G	Top-up of existing revetment with additional rock material and bank regrading	\$375 - \$625 per metre
K	Large organic debris or trees	\$1500 - \$2500 per tree
T	Timber groynes (piles)	\$10 - \$100 per metre

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on option
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

B10. MONITOR EROSION AT SITES BR02, BR13, BR14, BR15 AND BR16, BRUNSWICK RIVER

Description of Task

Actions required:

1. Undertake site survey and assessment of river (once a year or after a major flood event)
2. Monitor erosion.

Erosion and undercutting at these sites is not significant or active, however, may become so in the future and monitoring should be undertaken. At these sites there is either good riparian vegetation present and no public assets at risk, or the site might have a poor riparian zone but it is not considered justifiable to undertake works at the site in the foreseeable future.

BR02 is located at the confluence of Mullumbimby/Salt Water Creek and has severe but very localised erosion and very narrow riparian zone dominated by Camphor Laurel. Even though there is major bank undercutting at this site it is currently not considered justifiable to install any bank stabilisation works and should be monitored for erosion regularly.

Site BR13 is located in a deep channel area. There is moderate bank undercutting and erosion, with an undisturbed native (including saltmarsh communities) and well vegetated riparian zone (>10m width). Channel meander is active resulting in bank erosion and collapse, however, it is not currently considered justifiable to install any bank stabilisation works at this site. It is a hard site to access and at present there are no structures being threatened by the erosion.

Site BR14 has low banks and only minor undercutting with good native riparian vegetation present (>10m width). There is no risk to infrastructure or assets and currently it is not considered a priority for bank stabilisation works, however, should be monitored.

There is no active erosion present at BR15 and the presence of large woody debris has contributed to stabilise the bank. The riparian vegetation is good at this site, other than the narrow zone adjacent the cleared paddock.

Erosion and undercutting at site BR16 is no longer an issue as the mature trees have also fallen in the water and stabilised the bank. Mangroves and seagrass have recruited to the area further stabilising the bank.

It is useful to note that some sites were outlined in the previous CZMP (Issue No. 4, 2012) and the erosion has been stabilised by natural processes at some sites (fallen large trees and/or mangrove/seagrass recruitment) in the years preceding.



Photo - Site BR02 showing high steep collapsing bank.



Photos - Site BR13 showing moderate bank undercutting and erosion.

No photos of Site BR14



Photos - Site BR15 showing the presence of large woody debris.



Photos - Site BR16 showing the presence of fallen mature trees.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	Operational
Grant/Funding Options	-
Projected Date for Commencement	Within 3 years
Status	Underway (25% completion)

4.4.2 Priority Two Strategies

Recommended Strategy

B11. UNDERTAKE ON-GROUND WORKS (FORMALISE PUBLIC ACCESS AND REVEGETATION) AT SI07, SIMPSONS CREEK

Description of Task

Actions required:

1. Develop concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works
4. Formalise public access
5. Undertake revegetation works to increase riparian vegetation buffer.

This site is adjacent Brunswick Heads Scout Hall where significant but very localised bank erosion and slumping is occurring due to high usage by the public. Some works have been completed with a retaining wall and stairs constructed from the Hall down to the beach area. Due to public usage, the riparian vegetation is entirely missing or is in poor condition. The site would benefit greatly by improving the formalisation of public access to the beach and river bathing area, bank stabilisation works and restoration of the riparian vegetation buffer.



Potential options are illustrated below.

Option	Description	Indicative Cost (\$)
K	Large organic debris or trees	\$1500 - \$2500 per tree
N	Mangrove planting behind a rock toe	\$250 - \$375 per metre
P	Vegetation in riparian corridor	\$10 - \$62.50 per tree
S	Coir logs (incl. erosion control matting and tubestock sedge planting)	\$100 per metre ²
U	Formalisation of public access	\$ 1500 - \$ 2000 per metre

Implementation of Task

Lead Agency	Department of Industry - Lands
Total Cost Estimate	Dependent on options
Grant/Funding Option	-
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

Recommended Strategy

B12. UNDERTAKE ON-GROUND WORKS (REVEGETATION) AT SITES BR04 AND BR06, BRUNSWICK RIVER

Description of Task

Actions required:

1. Engage landowner to determine willingness to participate (BR06)
2. Undertake revegetation works to increase riparian vegetation buffer
3. Monitor erosion at site.

Site BR04 is located upstream approximately 100 m from the Mullumbimby Bridge. There is moderate bank undercutting and erosion evident with a steep bank and a large scalloped area. The riparian zone is well vegetated but narrow in width with a mix of natives and weeds. There are no public assets at risk. Increasing the width of the riparian zone is considered the most suitable management response for this site given the current condition.



Photos – Site BR04 showing large scalloped erosion area and undercutting.

Site BR06 is located upstream and downstream of the Mullumbimby train line river crossing and is approximately 400 m in length, extending 100 m downstream of the train line. Ad hoc revetment works have been recently installed in the form of a rock ramp to the river. There is moderate bank erosion and undercutting along a large section and a narrow riparian zone adjacent to cow paddocks. The riparian zone is Camphor Laurel dominated. Should the large Camphor Laurel trees fall into the river in the future, large sections of relatively unvegetated riverbank will be exposed to further erosion and slumping.

It is not currently considered justifiable to install bank stabilisation works at this site, however, erosion should be monitored and efforts made to increase the width and native condition of the riparian zone to improve ecological connectivity, value, and riverbank stability over the medium to longer term.

The private landholder will need to be engaged to determine their willingness to support riparian revegetation and cattle exclusion (if it is to be successful).

Potential options are presented below.

Option	Description	Indicative Cost (\$)
P	Vegetation in riparian corridor	\$10 - \$62.50 per tree



Photos – Site BR06 showing rock ramp revetment/pathway.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on options
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

Recommended Strategy

B13. UNDERTAKE ON-GROUND WORKS (STRUCTURAL BANK STABILISATION AND REVEGETATION) AT SITE BR07, BRUNSWICK RIVER

Description of Task

Actions required:

1. Engage landowner to determine willingness to participate
2. Develop concept designs and costing's
3. Prepare detailed designs
4. Undertake bank stabilisation works
5. Undertake revegetation works to increase riparian vegetation buffer.

Site BR07 is an existing site of the previous CZMP (Issue No. 4, 2012) and management of this site is still unresolved and the issue remains. Similar to site BR08 however, the bank undercutting and erosion is only moderate and not major. The riparian zone is narrow and sparsely vegetated, dominated with weeds. The primary cause of erosion at site BR07 is channel meander migration, accelerated by the lack of riparian vegetation and possibly wave action from the wind and boats. This has resulted in a relatively high and steep exposed and eroding bank. If the erosion process continues the narrow strip of riparian vegetation will be lost into the river. This site has a good intertidal bench for construction of rock and large woody debris (LWD), gravel/cobble fillets, bank regrading, and/or or rock revetment. In parallel with hard bank stabilisation work, a wide riparian buffer, replanted with native riparian vegetation should be established.



Potential options are presented below.

Option	Description	Indicative Cost (\$)
L	Gravel or cobble fillet on berm	\$125 - \$250 per metre
Q	Regrading of riverbank	\$25 - \$250 per metre
P	Vegetation in riparian corridor	\$10 - \$62.50 per tree

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on options
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

Recommended Strategy

B14. REPAIR BANK STABILISATION WORKS (TRAINING WALL) AT BR18, BRUNSWICK RIVER

Description of Task

Actions required:

1. Develop concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works.

This area is on the right bank of the Brunswick River along the training wall where the existing rock wall is failing and in need of repair. There is moderate bank erosion and if left unchecked, the rock wall may unravel further leading to larger erosion scallop. The failing rock wall presents a public safety risk and is contributing to general degradation of the riparian zone in this area. The length of the wall is potentially up to 100m that is in need of repair. To reduce the overall construction costs it would be beneficial to try and reuse the existing rock material.



Potential options are illustrated below.

Option	Description	Indicative Cost (\$)
F	Revetment reconstruction with existing materials and a new underlayer / geotextile	\$1000 - \$1,500 per metre
G	Top-up of existing revetment with additional rock material and bank regrading	\$375 - \$625 per metre

Implementation of Task

Lead Agency	Department of Industry – Lands
Total Cost Estimate	Dependent on option
Grant/Funding Options	-
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

Recommended Strategy**B15. UNDERTAKE ON-GROUND WORKS (REVEGETATION) AT SITE MA02 AND MA03, MARSHALLS CREEK****Description of Task**

Actions required:

1. Engage landowner to determine willingness to participate
2. Develop concept designs and costing's
3. Prepare detailed designs
4. Undertake revegetation works to increase riparian vegetation buffer.

These sites are located within the grounds of the Ocean Shores Country Club, in the upper Marshalls Creek area. There are small areas of localised erosion and under-cutting of the bank in some spots. Site MA02 has a steep river bank and MA03 has a very low riverbank. Riverbanks at both sites are fairly stable due to the presence of large native trees, however, the buffer of riparian vegetation is very narrow. Planting of a larger riparian buffer is recommended over an entire stretch of approximately 400 m (inclusive of both sites). At the time of updating the CZMP, Brunswick Valley Landcare were successful in obtaining funding for riparian vegetation planting and installation of coir logs at both sites MA02 and MA03.



Photo – Site MA03 with low stable river bank and narrow riparian zone..

Potential options are presented below.

Option	Description	Indicative Cost (\$)
P	Vegetation in riparian corridor	\$10 - \$62.50 per tree

Implementation of Task

Lead Agency	Brunswick Valley Landcare; Byron Shire Council
Support Organisation	Ocean Shores Country Club
Total Cost Estimate	Dependent on options
Grant/Funding Options	Habitat Action Grants Program
Projected Date for Commencement	Within 7 - 15 years
Status	Underway (25% completion)

4.4.3 Priority Three Strategies

Recommended Strategy

B16. UNDERTAKE ON-GROUND WORKS (REVEGETATION) AND MONITOR EROSION AT SITES BR01 AND BR05, BRUNSWICK RIVER

Description of Task

Actions required:

1. Undertake site survey and assessment of river
2. Engage landowner to determine willingness to participate (BR05)
3. Monitor erosion
4. Undertake revegetation works to increase riparian vegetation buffer.

There are a few sites along the Brunswick River which have eroded over the recent years but which appear to have currently stabilised somewhat. BR01 has moderate bank undercutting, slumping and erosion. The riparian zone is well vegetated (5-10m width) but is dominated with weeds. There are many Camphor laurels along the river bank and if they give way, then could cause significant bank collapse. There are no public assets at risk at BR01 and it is not currently justifiable to install any bank stabilisation works at this site. The site should be monitored on a yearly basis (or following 'major' flood events) and further efforts made to increase the width and condition of the riparian vegetation zone.



Site BR05 has a very high and steep bank with evidence of bank erosion and slumping. The riparian vegetation zone is well vegetated but narrow (0-5m width). At this moment there are no public assets at risk and it is not considered justifiable to install any bank stabilisation works at this site given the difficulty of the site. Along with BR01, this site should be monitored and effort applied to increase the width and condition of the riparian zone. .

Potential options are presented below.

Option	Description	Indicative Cost (\$)
P	Plant riparian vegetation buffer	\$10 - \$62.50

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	Operational
Grant/Funding Options	NA
Projected Date for Commencement	Within 15+ years
Status	Underway (25% completion)

4.5 On-Ground Works – other

4.5.1 Priority One Strategies

Recommended Strategy	
G1. REVIEW AND REASSESS THE MAIN ARM EFFLUENT REUSE SCHEME (MERS)	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Undertake a review of the Recycled Water Management Strategy 2. Continue liaising with farmers to identify potential for future upgrades 3. Reassess the Recycled Water Management Strategy and consider options <p>Byron Shire Council, in collaboration with local farmers, reuses 70% of the effluent discharged into the Brunswick River from the existing Mullumbimby sewage treatment plant. The project currently diverts effluent for reuse on two properties growing dairy and beef cattle. The system allows farms access to recycled water for irrigation use, thus reducing extraction of water from the Brunswick River and subsequently reducing the release of effluent into the river. The system is designed to be expandable, allowing more farms to be added as required.</p> <p>However, over the past 3 years recycled water used by the two local farmers has declined significantly. In the case of one farmer this is due to the cost of electricity and a decline in farming operations. To date BSC has found no new customers along the pipeline route. BSC is currently undertaking a review of its Recycled Water Management Strategy which is due to be completed in 2017. The review will build on the experience gained over the last 15 years of recycled water use.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	\$50,000
Grant/Funding Opportunities	-
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy	
G2. MARK NAVIGATIONAL HAZARDS, INCLUDING OYSTER LEASES AND STP OUTFALLS	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Develop consultation program to obtain details of existing navigational hazards 2. Undertake consultation program with waterways users and Maritime NSW to identify all navigational hazards 3. Mark all navigational hazards, including oyster leases, STP outfalls and tree snags. <p>The waterway users consulted during the '2002 Waterway Usage Survey' noted that the oyster leases and some tree snags were causing a navigational hazard. However, the exact number and specific location of each hazard was not noted. Therefore, this strategy will ensure that all of the hazards are identified through a consultation program and subsequently marked to improve safety on the waterways.</p>	
Implementation of Task	
Lead Agency	Roads and Maritime Services
Total Cost Estimate	\$7,500
Grant/Funding Opportunities	-
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

4.5.2 Priority Two Strategies

Recommended Strategy

G3. WORK WITH LANDHOLDERS TO REVEGETATE AND/OR FENCE THE RIPARIAN ZONE ALONG ALL WATERWAYS WITHIN THE BRUNSWICK ESTUARY

Description of Task

Actions required:

1. Identify priority areas for revegetation and/or fencing within the immediate estuarine catchment using vegetation mapping
2. Review works completed and assess priority riparian areas for revegetation and/or fencing
3. Liaise with landholders to determine their willingness to be involved in riparian corridor revegetation and/or fencing within their properties
4. Undertake revegetation and/or fencing of riparian corridors in consultation with landholders
5. Educate landowners and encourage undertaking best practice river bank and riparian restoration works.

There are extensive reaches of rural riparian land that have been cleared for agricultural purposes along the Brunswick Estuary. Many of these areas are prone to bank erosion and require revegetation of the riparian buffer zone. Some areas also have unrestricted stock access. Trampling of banks by livestock causes severe degradation of riverbanks accelerating erosion and increasing sediment loads to the waterways. Fencing off creek and riverbanks to control stock access would significantly reduce bank erosion and foster vegetation regeneration along the riverine corridor. Riparian vegetation provides a filter for catchment runoff thereby reducing nutrient and sediment loads entering waterways.

Byron Shire Council and Brunswick Valley Landcare have completed mapping and field truthing of the Brunswick catchment over the preceding years and many works involving riparian planting and bank stabilisation works have been completed and are ongoing (subject to funding availability). Brunswick Valley Landcare always encourage fencing and preservation of existing riparian vegetation, and some landowners are willing to undertake works, but costs can be too high for others. Therefore this strategy needs to be implemented through collaboration with landowners and Byron Shire Council and Brunswick Valley Landcare sourcing funds for revegetation and fencing works with owner contribution as well.

Potential options are presented below.

Option	Description	Indicative Cost (\$)
P	Vegetation in riparian corridor	\$10 - \$62.50 per tree
-	Fencing	\$50 per metre

Implementation of Task

Lead Agency	Byron Shire Council and Brunswick Valley Landcare
Total Cost Estimate	Dependent on option
Grant/Funding Opportunities	NSW Environmental Trust; Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

4.5.3 Priority Three Strategies

Recommended Strategy	
G4. MAP AND ERADICATE WEED INFESTATIONS BY SURVEY, EDUCATION AND WEED MANAGEMENT PROGRAMS	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Seek funding through grants and work with local Landcare groups to identify, survey and map areas for abundance and distribution of environmental weeds 2. Identify weed “hotspots” and priority areas for action 3. Target those weeds that pose a social, environmental or economic threat to the catchment values 4. Co-ordinate weed management programs in alignment with the North Coast Regional Strategic Weed Management Plan & Biosecurity Act / Regulations (2015) 5. Remove weeds applying an Integrated Pest Management approach to the manage weeds based first on prevention and when needed, a control (biological, cultural, physical or mechanical intervention). Saving a registered herbicide application as a last resort <p>There is a considerable amount of Council-owned land that is affected by weed invasion. Any weed control strategy needs to consider Council’s regulatory requirements, flora and fauna habitat requirements, adjacent land uses, soil stability and maintenance of water quality.</p> <p>The “Brunswick River Estuary Study” (2002) and Byron Shire Council identified Camphor laurel as the most conspicuous weed in the lower Brunswick Catchment. Byron Shire Council mapped the spread of this species in 1999 and found that its spread along the Main Arm of the Brunswick Estuary and throughout the catchment is extensive. There are, however, a number of other conspicuous and less conspicuous weeds throughout the catchment, but are often localised in their distribution. Weed mapping was completed 2011 by Brunswick Valley Landcare as part of the 'Brunswick River Reach Estuary Plan' and vegetation mapping was completed by Byron Shire Council in 2015. Due to the length of time since weed mapping was undertaken and possible change in property ownership, it would be beneficial to undertake a more recent surveillance of weeds within the catchment.</p> <p>The NSW North Coast Weeds Advisory Committee has developed a “North Coast Regional Strategic Weed Management Plan 2017 - 2022”. Reference to this strategy, applicable legislation and the ‘Byron Biodiversity Conservation Strategy’ (2004) should be undertaken in developing any Weed Management Program for areas within the Brunswick Estuary Catchment.</p>	
Implementation of Task	
Lead Organisation	Byron Shire Council
Total Cost Estimate	\$20,500
Grant/Funding Opportunities	NSW Environmental Trust
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

4.6 Investigation and Research

4.6.1 Priority One Strategies

Recommended Strategy

IR1. DETERMINE CURRENT STATUS OF RECREATIONAL AND COMMERCIAL ACTIVITIES AND THEIR IMPACTS ON ESTUARY HEALTH AND USER VALUES AND DEVELOP A GUIDANCE DOCUMENT FOR THE SUSTAINABLE MANAGEMENT OF THE ESTUARY

Description of Task

Part A: Determine current status of recreational and commercial activities and their impacts on estuary health and user values.

Actions required:

1. Determine environmental and social values of the estuary and establish baseline conditions of estuary health (seagrass beds, mangroves saltmarsh etc)*
2. Undertake a basic impact assessment of recreational and commercial activities on estuary health
3. Undertake a basic impact assessment of recreational and commercial activities on user values of the estuary
4. Determine current status of recreational and commercial activities and their impacts on estuary health and user values
5. Assess different scenarios based on increased activities
6. Establish management actions and measures to ensure the sustainable management of recreational and commercial activities on the health and user values of the Brunswick Estuary

**Outcomes and results of Recommended Strategies M1 and IR4 can be used to inform this impact assessment (if implemented)*

Part B: Develop and implement a guidance document for assessment and sustainable management of commercial activity licences and activities in the Brunswick Estuary

Actions required:

1. Review outcomes of impact assessment (Part A) and establish assessment criteria for the sustainable management of licences
2. Develop a specific Guidance Document for use by Public Agencies to assess the licencing of existing and future commercial activities
3. Create an Memorandum of Understanding (MOU) between agencies involved in Commercial Activity Licences (Byron Shire Council, Department of industry – Marine Parks and Department of Industry - Lands).

Tourism numbers are on the increase in Brunswick Heads, with recreational and commercial activities putting increasing pressure on the natural environment, predominantly over the holiday period. Even passive activities such as kayaking and stand up paddle boarding can lead degradation of seagrass beds, saltmarsh areas, and riverbanks through trampling and ingress/egress of these non-motorised vessels. This increase in activities, whether recreational or commercial, can also lead to user conflicts over limited space at boat ramps and decrease in the overall amenity of the estuary.

The aim of this management strategy is to firstly determine the environmental/social values of the estuary and present ecosystem health through a basic review of literature, studies and any outcomes/results of the implementation of Management Strategies M1 and IR4. Once knowledge of the existing health and user values of the estuary is known, a basic impact assessment can then be completed. This assessment will help determine the current status of recreational and commercial activities and their impacts on estuary health and user values. An assessment of different scenarios should then be undertaken to predict potential impacts to estuary health and used values, and to inform the implementation of management actions (such as amending the number of Commercial Activity Licences). An understanding of the limit or carrying capacity of the estuary to increased usage will help agencies better manage commercial licencing into the future and to ensure the sustainable management of estuary.

The second part of this strategy is to develop a Guidance Document for use by Public Agencies, which will help guide agencies in licensing commercial activities based on potential environmental and social impacts. This document will help guide the sustainable management of commercial activities on the Brunswick River and estuary as a whole. An outcome of the development of the Guidance Document will be to form an MoU between agencies involved, in order to proactively manage licensing, ensure licence conditions are met and monitor and mitigate potential impacts from activities.

Implementation of Task

Lead Agency	Byron Shire Council; Department of Primary Industries – Marine Parks; and Department of Industry - Lands
Total Cost Estimate	Operational
Grant/Funding Opportunities	Coastal and Estuary Grant Program (OEH; NSW Environmental Trust
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy	
IR2. INVESTIGATE WATER QUALITY ISSUES IN THE CAPRICORNIA CANAL SYSTEM	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Advise Southern Cross University of post-graduate research project to investigate water quality issues in the Capricornia Canal system 2. Undertake water quality modelling and any necessary field sampling 3. Write up report on findings and provide to Byron Shire Council for consideration and action. <p>The flow of deoxygenated water from the swamplands to the north of North Ocean Beach during or following a flood is a natural phenomenon. However, its impact on aquatic life within Capricornia Canal is exacerbated by the Kallaroo Circuit Bund. The bund regulates water from the north, while the restricted channel to the south of the canal regulates water to Marshalls Creek.</p> <p>As deoxygenated water will continue to flow from the swamplands in the future, improving the flow through the canal and into Marshalls Creek will allow more time for this “toxic” water to become oxygenated / assimilated prior to reaching Marshalls Creek. A modelling exercise is required in order to determine the water quality issues within Capricornia Canal This may be undertaken by a post-graduate student at the university to minimise the cost of this project.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	\$12,000
Grant/Funding Opportunities	NSW Environmental Trust
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

IR3. UNDERTAKE POINT SOURCE SAMPLING AT THE STORMWATER OUTFALL(S) ADJACENT TO THE MILL STREET INDUSTRIAL AREA, THE FORMER BRUNSWICK HEADS TIP SITE AND BOAT HARBOUR / MARINA TO DETERMINE POTENTIAL SOURCES OF TRACE METAL AND CHEMICAL TOXIN INPUT TO THE ESTUARY

Description of Task

Actions required:

1. Undertake point source sampling at stormwater outfalls adjacent to the Mill Street industrial area, the former Brunswick Heads Tip site and the marina to determine presence of trace metal discharges (particularly lead and copper) in stormwater discharge
2. Identify those industries that may produce trace metals as a by-product of their operations or whether there are pre-1970s' painted buildings within the complex
3. Issue warning letters and/or penalty notices to non-compliant businesses / activities
4. Distribute industry-specific information brochures (such as EPA guidance) to all businesses to encourage "Cleaner Production"
5. Introduce rewards and issue penalties for best and unacceptable practices, respectively
6. Undertake point source sampling one month after warning letters / penalty notices have been issued.

The drainage mapping provided by Byron Shire Council does not clearly show how the Mill Street Industrial area is drained and where the outfall(s) is (are) located. However, based on the stormwater drainage layout for the surrounding area, it is likely that there is only one outfall for the industrial site. This could potentially make it difficult to determine which specific industry is discharging pollutants.

However, sampling the outfall will confirm whether trace metals are present in the stormwater discharging from this site. Sampling could be undertaken as a stormwater audit similar to that undertaken in the Byron Bay industrial area.

The source of lead from the Mill Street Industrial Area may be from old buildings on the site that were painted pre-1970s with lead-based paint. This may be leaching into the stormwater system. It is likely that copper contamination within the marina is derived from the anti-fouling paint used on the hull of boats. These industries should be given industry-specific "Cleaner Production" brochures. Information that can help industries decrease environmental pollution can be found on the NSW Environmental Protection Authority's website.

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	\$4,200
Grant/Funding Opportunities	NSW Environmental Trust; Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

4.6.2 Priority Two Strategies

Recommended Strategy	
IR4. UNDERTAKE BENTHIC HABITAT MAPPING TO PROVIDE ASSESSMENT OF THE HEALTH OF THE ESTUARY	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Advise Southern Cross University of research project in the Brunswick Estuary 2. Undertake benthic habitat mapping of seagrass, mangrove and saltmarsh communities in the Brunswick Estuary (based on the methods used by DPI and the most recent mapping completed) 3. Write up report on findings and provide to Byron Shire Council for consideration 4. Use results for consideration of other research activities to improve the health of ecosystems in the Brunswick Estuary 5. Habitat mapping to compliment and assist in interpretation of the results of the Ecohealth Program (<i>Refer - Recommended Strategy M1</i>). <p>Benthic habitat maps are an important and essential means of providing marine resource assessments for coastal management. Mapping of benthic habitats is critical to improve our understanding of ecosystems dynamics and the relationships between biota and habitats in the Brunswick Estuary. The estuary is part of the Cape Byron Marine Park and contains various ecosystems such as seagrass meadows, oyster reefs, mangroves and saltmarsh. Understanding the status and condition of estuarine habitats is an important step in being able to assess trends in time and to set management actions to improve the health of the estuary. There is currently very little comprehensive spatial information about the extent of marine habitats and the condition of marine resources along the coast of NSW (refer to the DPI website). The most recent mapping of the Brunswick River is based on aerial footage (dated 2000) and a field survey undertaken in 2004 by the then Department of Industry and Investment.</p> <p>An update of this mapping will help compare the present extent and condition of ecosystems and habitats within the Brunswick Estuary, and also help monitor the effectiveness of management strategies implemented. Updated mapping can also compliment and assist in the interpretation of results from the implementation and delivery of the Ecohealth Program (<i>Refer - Recommended Strategy M1</i>), and initiate further research projects to improve the health of the estuary (such as the installation of oyster reefs, <i>see note below</i>).</p> <p>The overall objective of the mapping project will be to determine if seagrass beds, mangroves, saltmarsh etc. are continuing to decline or recover as these ecosystems are a marker for water quality and habitat disturbance.</p> <p>Note: Presently there is a push to install hard substrates within estuaries to provide a surface upon which oyster spat can settle and grow and re-establish reefs. Oysters are great filters of estuaries and have been known to filter all the water in the estuary every 3 days. There are still a few oyster reefs in the Brunswick Estuary, which would be great to identify and expand upon them. The reefs also provide great habitat for other biota.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council and the Department of Primary Industries - Fisheries
Total Cost Estimate	\$15,000
Grant/Funding Opportunities	-
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

Recommended Strategy	
IR5. UNDERTAKE DRAIN MAPPING WITHIN THE NORTH AND SOUTH OF THE BRUNSWICK RIVER AND THE MARSHALLS CREEK SUBCATCHMENT AREA	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Review 1:25,000 aerial photographs and topographic surveys to determine location of existing drainage, including landholder drains and union drains 2. Devise code for depth, width and height of spoil mound to the nearest one metre 3. Undertake ground truthing to confirm existing length, width and depth of drains 4. Develop GIS layer detailing locations and characteristics (width, depth and spoil height) of drainage within the Marshalls Creek subcatchment area. <p>Sulphide derived acidification is likely to be due to drainage of land subject to acid sulfate soils transported by drains to the estuary. As previously mentioned in strategy P5, an Acid Sulfate Soil Management Plan (ASSMP) is required for the estuary. However, at present there is insufficient information on the extent of acid sulfate soils and agricultural drains throughout the catchment. A drain mapping exercise will assist in providing a basis for the development of an ASSMP for the catchment.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	\$17,500
Grant/Funding Opportunities	Floodplain Management Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy	
IR6. UNDERTAKE A SOIL SURVEY OF POTENTIAL ACID SULFATE SOILS (ALONG MARSHALLS CREEK, SIMPSONS CREEK AND THE BRUNSWICK RIVER)	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Undertake a detailed topographical survey of those areas identified by the OEH Acid Sulfate Soil Risk Maps as areas of PASS 2. Identify those areas less than 5m AHD 3. Undertake a field and vegetation survey of low-lying areas to determine presence of acid scalds, iron staining, jarosite and death of vegetation 4. Determine borehole locations for soil sampling 5. Undertake soil sampling 6. Develop GIS layer to be used by Council staff when assessing development applications, etc. 7. Data to be used in development of an Acid Sulfate Soils Management Plan (<i>Refer - Recommended Strategy P5</i>). <p>There is currently no detailed data on acid sulfate soils in the Brunswick Estuary. These soils are naturally sediment deposited under estuarine conditions. When exposed to oxygen through drainage or disturbance, these materials produce sulphuric acid and often releasing toxic quantities of metals. Because of its estuarine origin, acid sulphate soil material is only found at very low elevations, generally <1 m AHD. The geomorphic data used for creating the OEH Acid Sulfate Soil Risk Maps does not provide reliable information for the development of an ASS Management Plan for the area. It is therefore essential that a suitable soil survey is undertaken to map the actual distribution of PASS in the Brunswick estuarine system.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	\$26,500
Grant/Funding Opportunities	Floodplain Management Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

4.6.3 Priority Three Strategies

Recommended Strategy	
IR7. CONDUCT AUDIT OF ALL WEIRS AND PUMPS ON ALL STREAM CATCHMENTS IN THE BRUNSWICK CATCHMENT TO ACCURATELY ASSESS THEIR IMPACT	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Obtain DPI records on all pumps within the Brunswick Estuary 2. Identify all weirs, pumps and water extractions within the estuary using DPI records, WaterNSW (for pump records and licenced weirs) and previous studies 3. Audit all structures by boat and by foot (as necessary) using a GPS system to record their location 4. Identify those having the greatest impact on catchment flows, fish migration and infiltration through consultation with the NSW Department of Primary Industries 5. Determine potential management actions / options for reducing the impact of existing structures on catchment flows and infiltration 6. Consult with community on proposed management actions 7. Undertake improvement / modification works 8. Monitor flows to assess effectiveness of modified structures; this may be achieved by integrating with existing Landcare programs to estimate stream flows in the catchment, and to also estimate the impact on fish migration upstream. <p>Weirs appear to have a severe impact, particularly in low flows. There is limited data on weirs, pumps and water extractions within the Brunswick catchment. A survey of structures restricting tidal flow was undertaken on the NSW Coast by Williams and Watford (1996). The study identified ten structures within the Brunswick Estuary. However, as that was twenty years ago, there may have been some changes since the survey was undertaken. The study should, however, be used as a baseline for auditing the weirs throughout the estuarine catchment.</p> <p>A survey of two catchment streams was undertaken as part of the 'Brunswick River Estuary Study' (MHL, 2002). However, the variation in pump and weir numbers found in this survey on two similar branches of the river suggests that a separate survey is required for each waterway in the catchment to obtain an accurate assessment of their numbers, location and impacts. This study found up to six structures within one catchment stream, which suggests that the Williams and Watford (1996) study did not identify all the structures that are now present along the tributaries of the Brunswick Estuary. Similarly, the number of pumps identified during the 2002 study was significantly greater than that recorded on the DPI database of pumps and is possibly due to stock and domestic use for which DPI would likely not have records.</p> <p>More recently, DPI completed an audit of waterway assets in 2004/05. While it attempted to be exhaustive in the assessment, it was limited by time and access in some cases. It is therefore recommended, given the small size of the catchment, that a comprehensive ground truthing assessment be undertaken. Once a GIS layer has been developed it could overlay with fish barriers. This would help to know where pumps may be impacted if the upstream water level is drawn down.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council
Support Agency	Department of Primary Industries - Fisheries, Water NSW

Total Cost Estimate	\$5,500
Grant/Funding Opportunities	NSW Recreational Fishing Trust; Habitat Action Grants Program
Projected Date for Commencement	Within 10 years
Status	Not started (0% completion)

Recommended Strategy

IR8. ASSESS THE DISTRIBUTION AND ABUNDANCE OF FISH STOCKS IN THE BRUNSWICK ESTUARY

Description of Task

Actions required:

1. Advise Southern Cross University of research project initiative
2. Develop research question
3. Undertake survey of fish abundance within the Brunswick River
4. Collate information and report on fish abundance
5. Undertake survey of fish abundance in three to five years' time to determine any changes in species or distribution
6. Undertake management actions as necessary to control recreational fishing.

The "Brunswick River Estuary Study" (MHL, 2002) found that there was a reported reduction in fish stocks as a result of recreational fishing. However, in the review and update of the CZMP (Issue No.5, April 2017) Marine Parks and DPI - Fisheries were not aware of any significant reduction in fish stocks in the Brunswick River (outcomes of the Audit – refer to Appendix B). In order to ascertain the distribution and abundance of fish stocks in the estuary, a project to monitor fish stocks would be beneficial. Presently DPI – Fisheries is moving away from monitoring with a focus more on research questions, leaving monitoring more for universities and private entities. A grant with a University would likely be the best option to verify any reduction in fish stocks, tied to a research question such as "*if we do X habitat improvement works, what will be the impacts on fish species diversity and abundance*".

Monitoring of fish stocks should occur but be undertaken in a professional manner, and could be combined with implementation of the Ecohealth Program (*Refer - Recommended Strategy M1*).

A monitoring project to better understand the distribution and abundance of fisheries resources in the Brunswick River and its tributaries would be greatly supported by Marine Parks and should be implemented if funding becomes available. An increase in fishing (recreational) pressure has been observed with a further increase likely with any upgrade of local boat launching facilities. Monitoring of mud crabs in marine park sanctuary zones (SZs) has indicated that crabs in SZ are significantly larger and more abundant than mud crabs in fished areas (comments from Marine Parks and outcomes of the Audit – *refer - Appendix B*).

This research project will provide a better understanding of the impacts that recreational fishing is having on fish stocks, and the effect of the declaration of the Cape Byron Marine Park.

Implementation of Task

Lead Agency	Department of Primary Industries – Fisheries
Total Cost Estimate	\$18,000
Grant/Funding Opportunities	-
Projected Date for Commencement	Within 10 years
Status	Not started (0% completion)

4.7 Monitoring

4.7.1 Priority One Strategies

Recommended Strategy	
M1. DEVELOP AND IMPLEMENT THE ECOHEALTH PROGRAM IN THE BRUNSWICK ESTUARY REPORTING ON ESTUARINE AND FRESHWATER HEALTH OF THE WATERWAY	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Prepare media release advising community of the plan to establish water quality and ecosystem monitoring within the Brunswick Estuary (and other areas in the Byron LGA if applicable) 2. Develop and implement the Ecohealth Program (as part of the North Coast Bioregion Ecohealth Program) using sampling protocols and data analysis developed by OEH and the University of New England. 3. Undertake field sampling of ecohealth indicators at required intervals (annually) 4. Report on water quality and ecohealth indicators in regular 4 yearly report cards in the State of the Environment Report and on the Byron Shire Council website / local media. <p>BSC does not currently have an active water quality program in the Brunswick Estuary. Sampling was ceased with the construction of the new STP at Vallances Road, Mullumbimby.</p> <p>Water quality in the estuary has no doubt improved significantly due to the reduction in STP wastewater nutrient loads, however, the current state of the quality of water is unknown as there has been no sampling undertaken in recent years (since 2009).</p> <p>The NSW Natural Resources Monitoring, Evaluation and Reporting (MER) Strategy 2010-2015 guides the monitoring, evaluation and reporting of natural resources in NSW. The strategy focuses on developing a link between local, regional, state and national data on natural resource management (NRM) that will inform the community about how we care for the natural resources of NSW (OEH accessed online at http://www.environment.nsw.gov.au/soc/NaturalresourcesMER.htm, 29 May 2017).</p> <p>Under the NSW MER strategy, a Northern Rivers Ecosystem Health Monitoring Program (Ecohealth) has been developed which is a comprehensive estuarine and freshwater monitoring program that reports on the health of waterways. It aims to bring together the aquatic sampling programs of local and state government and other stakeholders into one region-wide system. The program was designed by the University of New England with input from the Office of Environment and Heritage. Sampling is undertaken at certain locations and sites for an established set of criteria/parameters on a regular basis, similar to the 'South East Queensland Ecosystem Health Monitoring Project'. Waterway health is scored and presented in easily interpreted report cards.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council
Support Organisation	Office of Environment and Heritage
Total Cost Estimate	\$18,000 per year
Grant/Funding Opportunities	Coastal and Estuary Grants Program
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

4.8 Education and Public Relations

4.8.1 Priority One Strategies

Recommended Strategy	
E1. EDUCATE COUNCIL PLANNING STAFF ON THE IMPACTS OF PLANNING DECISIONS ON ESTUARY WATER QUALITY	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Develop a council staff education program that outlines the importance of estuary processes and the potentially adverse impacts of development (i.e., untreated and uncontrolled stormwater runoff, clearing of vegetation, sedimentation, etc.) 2. Undertake two one-day workshops with Council Planning staff. <p>Raising awareness of the impacts of land use Planning decisions and development approvals through a council staff education program is an effective and relatively simple management action. A targeted education program for Council Planners will raise their awareness of the negative impacts on the estuary as a result of vegetation clearing and untreated stormwater runoff from new developments.</p> <p>Ultimately, the implementation of this strategy should lead to better Planning decisions, improved water quality, retention of catchment and riparian vegetation and a reduction in pollutant and sediment loadings.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	\$1,500
Grant/Funding Opportunities	-
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy**E2. PREPARE AND UNDERTAKE A TARGETED EDUCATION PROGRAM FOR RURAL PROPERTY OWNERS TO MAKE THEM AWARE OF BEST PRACTICE CATCHMENT MANAGEMENT****Description of Task**

Actions required:

1. Publish a media article inviting all rural property owners to workshops
2. Undertake workshops for rural property owners at local community hall
3. Distribute industry-specific education brochures to all landholders.

The rate at which sediments enter the estuary can be controlled in a number of ways. In addition to planning controls, such as restricting land clearing and development, and physical works such as bank stabilisation works and revegetation of riparian buffer strips, educating the community on desirable landuse practices and “best practice” catchment management methods will assist in reducing the overall sediment load to the estuary.

Byron Shire Council and Brunswick Valley Landcare are actively involved in community education activities and hold regular workshops, community events and vegetation planting days. Brunswick Valley Landcare have been working regularly with local landowners educating them on “best practice” catchment management methods such as:

- Minimisation of slope erosion
- Minimisation of gravel loss and bank erosion at river crossings
- Controlling cattle access to waterways
- Minimisation of vegetation clearing
- Replanting of native catchment riparian vegetation
- Appropriate application (timing and location) of fertilisers.

Most landowners along riparian zones are aware of the importance of riparian vegetation and “best practice” but lack the funds or extension support to get the correct works happening on the ground. In parallel with this strategy and holding regular education activities, there is a great need to allocate funds to on-ground works (*Refer – Recommended Strategy G3*), with sufficient funds allocated for follow-up maintenance work.

Implementation of Task

Lead Agency	Byron Shire Council and Brunswick Valley Landcare
Total Cost Estimate	\$2,000
Grant/Funding Opportunities	NSW Environmental Trust
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy**E3. EDUCATE THE COMMUNITY ON THE IMPACTS OF HUMAN ACTIVITIES ON ESTUARY PROCESSES****Description of Task**

Actions required:

1. Develop a community education program that outlines the importance of estuary processes and the potentially adverse impacts of human activities.

The program should include:

- the distribution of community information brochures
- media exposure of events in which beneficial works are implemented within the estuary or along its shoreline
- field days to show the benefits of works such as fencing-off of river and creek banks
- regular newspaper articles detailing the activities of Byron Shire Council in implementing the plan.

2. Develop and distribute a brochure aimed at the whole community which describes the most pressing issues facing the future management of the estuary.

The brochure should highlight issues such as:

- The impact of untreated and uncontrolled stormwater runoff on estuary water quality
- The impact of clearing of vegetation both along creek corridors and across the broader catchment
- The impact of fertiliser use on lawns on estuary water quality and aquatic plant growth.

As outlined in the Site Survey undertaken for the revision and update of the CZMP, there were many suburban sites along the reaches of the estuary where property owners have cleared riparian vegetation and installed ad-hoc structures and pontoons (Sites SI01, MA01 and MA06). Raising awareness through a community education program advising the value of the estuary, riparian vegetation and, most importantly, the impact of human activities on the estuary is an effective and relatively simple management action. The education program should include fostering an understanding of estuarine ecology and awareness of key management issues as this will assist in ongoing effectiveness and reception of more specific initiatives such as the environmental report card, riparian and stormwater awareness campaigns.

It is recommended that the community education program should begin with a global brochure aimed at the whole community describing the key issues facing the estuary. This global brochure could then be followed up with handouts targeting selected community groups (e.g., riparian land owners, fishermen, sailing clubs, etc.) outlining simple actions that individuals can undertake to reduce the impact of human activities on estuary processes. An example of a brochure that could be distributed to households can be found in Appendix H.

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	\$12,000
Grant/Funding Opportunities	NSW Environmental Trust
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

5 Implementation of the CZMP

The possible impacts on natural systems and human development resultant from Climate Change must be considered in the implementation of all management strategies recommended in this CZMP. In designing and/or implementing the recommended management strategies, an assessment of the impacts of Climate Change on each strategy must be incorporated into the design of that strategy, under consideration of the design life of that strategy using the most up to date information available.

Please refer to Appendix D for a description of the requirement for planning for climate change in the development and implementation of the strategies outlined in this CZMP.

5.1 Implementation Schedule

A detailed listing of the prioritised actions is provided in an Implementation Schedule, which has been developed in a similar fashion to a “capital works program”.

The Implementation Schedule has been prepared to assist in the process of acquiring funding to undertake the prioritised strategies and to assign responsibilities for completing associated tasks. The implementation schedule is provided as Table 5-1 and includes:

- a description of the proposed strategy
- the adopted priority ranking for each strategy, which effectively determines the expected date of commencement of works
- a list of sub-tasks to be undertaken to effect each specific strategy
- the party or government agency responsible for undertaking or coordinating the investigation / work
- an estimate of the cost to complete the strategy
- funding options for implementing the strategy
- status of the proposed strategy
- start time frame for implementation of the proposed strategy

5.2 Funding Options

Funds for natural resource management projects are scarce, and must be spent effectively and accountably. A number of the actions under consideration require substantial capital and/or maintenance costs and an expanded commitment of staff resources. Relatively high capital costs are, for instance for any structural controls that may be required to stabilise bank erosion.

The actions in the CZMP will require funds from Byron Shire Council budgets, from the recurrent funds in the OEH, DoP, and NSW DPI budgets, grants, industry contributions and in-kind contributions from the community.

A range of incentives such as taxes and subsidies, cross compliance programs, tradeable rights, market gains, etc., will assist in achieving changes in agricultural land practices. Cross compliance and rate reduction programs should be investigated first and would become part of formal agreements with landholders.

Section 94 contributions from new development along the estuary could also be used to assist with the funding of estuary management activities. The funds available from Section 94 will not necessarily be large, but they may be sufficient to provide seeding money to obtain further funds from elsewhere.

At the time of implementing a management strategy applicable funding may not be available and alternate funds/grant programs may need to be researched. The range of present available funding

options is listed below. A detailed description of each funding option and the timing for applications is included in Appendix G.

- NSW Environmental Trust
- North Coast Local Land Services Funding Programs
- Public Reserves Management Fund
- NSW Heritage Incentives Program
- NSW Coastal and Estuary Grants Program
- NSW Recreational Fishing Trust
- Habitat Action Grants Program
- NSW Maritime Infrastructure Program
- Small Grants for Rural Communities.

Table 5-1 – Implementation Schedule of Recommended Management Strategies

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	COST	LEAD AGENCY	STATUS
	PLANNING CONTROLS AND POLICIES					
P1	Council Planners to ensure future residential rezoning's include forested buffer zones between agricultural and new residential lands in Mullumbimby and Bayside Brunswick	1	<ol style="list-style-type: none"> 1. Council planners to ensure that future residential rezoning's include forested buffer zones between agricultural and new residential lands at: <ul style="list-style-type: none"> - Ann Street, Mullumbimby; - Bayside Brunswick; Existing residential zoned land on Main Arm Road, Mullumbimby; - Clays Road / Coral Avenue; and, - Left Bank Road, Mullumbimby. 2. Involve local Landcare groups to create buffers between existing town / agricultural boundaries 3. Introduce farm forestry planting incentives for land owners. Planting could be tax deductible if linked to other agricultural production 4. Encourage rural landholders to prepare Property Management Plans with the North Coast Local Land Services. 	Operational	Byron Shire Council	Underway
P2	Prepare the North Byron Coastal Creeks Flood Study to incorporate the impacts of Climate Change	1	<ol style="list-style-type: none"> 1. Prepare the North Byron Coastal Creeks Flood Study incorporating modelling of Marshalls, Simpsons and Brunswick Catchments. The study is to consider the areas of Mullumbimby, Brunswick Heads, Ocean Shores, New Brighton and South Golden Beach. 2. Develop a Flood Risk Management Study and Plan for these areas. 3. Incorporate the impacts of climate change into the Flood Risk Management Study and Plan based on Council's adopted climate change parameters. 	\$75,000	Byron Shire Council	Underway
P3	Incorporate any remaining vacant foreshore Crown Land into a formal public land management regime and prepare Plans of Management for all Crown Lands within an integrated estuary / foreshore reserve system	2	<ol style="list-style-type: none"> 1. Liaise with the Department of Industry - Lands to identify all Crown Reserves adjacent the Brunswick Estuary that do not have a current Plan of Management. 2. Prepare draft Plans of Management. 3. Undertake community consultation to obtain community feedback on draft Plans of Management. 4. Finalise reports. 	\$71,500	Department of Industry - Lands	Underway
P4	Prepare a WSUD Policy for the Byron Shire	2	<ol style="list-style-type: none"> 1. Council to prepare a draft WSUD in consultation with State Agencies, industry and the community 2. Undertake public exhibition of draft document 3. Finalise WSUD Policy 4. Council adoption of WSUD policy 5. Developers advised of new policy and provided with fact sheets on key techniques 6. Implementation of WSUD Policy 	\$18,750	Byron Shire Council	Not started
P5	Develop an Acid Sulphate Soils Management Plan (ASSMP) for the catchment	3	<ol style="list-style-type: none"> 1. Undertake a soil survey of the area to the north and south of the Brunswick River, and the Marshalls Creek sub-catchment 2. Undertake water quality monitoring to determine sites of acid runoff 3. Prepare whole farm plans for properties on high risk ASS. 4. Review and assess Marshalls Creek Floodplain Management Plan to identify areas with high probability for development. 5. Develop ASS Management Plan in accordance with the NSW Acid Sulfate Soil Manual. 6. Establish ASS demonstration sites, such as at the Kallaroo Circuit Bund / Capricornia Canal area. 7. Organise awareness and education activities such as field days, information bulletins and newsletters. 	\$60,000	Byron Shire Council	Not started
	ECONOMIC INCENTIVES AND COST-SHARING ARRANGEMENTS					
C1	Introduce a community Environmental Grants Scheme for implementing on-grounds works towards biodiversity conservation	2	<ol style="list-style-type: none"> 1. Investigate and determine the possibility of introducing an Environmental Grants Scheme 2. Secure initial funding for start-up of scheme 3. Establish continued funding and potential long-term funding options. 4. Introduce grants scheme to community. 5. Publish media article advising rural land owners of Environmental Grants Scheme and how to apply 6. Implement Environmental Grants Scheme through the BSC website. 	\$12,000	Byron Shire Council	Not started
	REGULATION					
R1	Lobby for review of speed limits within the Brunswick River and Marshalls Creek	1	<ol style="list-style-type: none"> 1. Council to lobby Roads and Maritime Services on review of speed limits within the Lower Brunswick Estuary. 2. Prepare community information brochures on new speed restriction zones 3. Prepare media release advising of new speed restriction zones 4. Install signs in prominent foreshore locations clearly specifying new speed restrictions. 	Operational	Byron Shire Council, and DPI - Marine Parks	Not started

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	COST	LEAD AGENCY	STATUS
	REGULATION					
R2	Investigate and enforce potential illegal rock armouring in all reaches of the Brunswick Estuary	1	1. DPI - Fisheries to investigate and enforce sites of potential illegal rock armouring 2. DPI - Fisheries to liaise with BSC and review development approvals documentation to determine whether rock armouring has appropriate BSC and DPI - Fisheries approval 3. Undertake enforcement action where appropriate 4. Encourage land owners to undertake recommended bank stabilisation options	Operational	Department of Primary Industries – Fisheries and Byron Shire Council	Progressing
R3	Investigate and enforce illegal camping at areas adjacent the Brunswick Estuary		1. BSC and Department of Industry - Lands to investigate illegal camping along all reaches of the Brunswick Estuary 2. Undertake enforcement action where appropriate 3. Encourage land owners to limit illegal camping by fencing off areas, or advising regulatory authorities when illegal camping is observed	Operational	Department of Industry – Lands and Byron Shire Council	Underway
R4	Investigate and enforce encroachment of built structures and clearing of riparian vegetation at areas adjacent the Brunswick Estuary		1. BSC and DPI - Fisheries to investigate illegal landowner development (built structures) and riparian vegetation clearing along all reaches of the Brunswick Estuary 2. Undertake enforcement action (where appropriate) 3. Landowners to remove structures and restore riparian vegetation buffer (where appropriate)	Operational	Department of Primary Industries - Fisheries and Byron Shire Council	Underway
	ON-GROUND WORKS - riverbank stabilisation, revegetation and repair					
B1	Undertake on-ground works (revegetation) at bank erosion sites SI03 and SI04, Simpsons Creek and BR17, Brunswick River	1	1. Engage landowner to determine willingness to participate 2. Formalise or restrict public access in consultation with landowner and key stakeholders 3. Compliance action on illegal camping (refer to Management Strategy R3). 4. Undertake revegetation works to increase riparian vegetation buffer.	Dependent on option.	Byron Shire Council and Department of Industry - Lands	Not started
B2	Undertake on-ground works (structural bank stabilisation and revegetation) along Simpsons Creek at bank erosion sites SI05 and SI06	1	1. Develop precinct plan, concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works / formalise public access 4. Undertake revegetation works to increase riparian vegetation buffer.	Dependent on option.	Byron Shire Council, Department of Primary Industry - Lands and NSW Crown Holiday Parks Trust	Not started
B3	Repair bank stabilisation works along Simpsons Creek at bank erosion sites SI08 and SI09	1	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works	Dependent on option.	Department of Industry - Lands	Not started
B4	Undertake on-ground works (structural bank stabilisation and revegetation) along Marshalls Creek at bank erosion site MA04	1	1. Develop precinct plan, concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works / formalise public access 4. Undertake revegetation works to increase riparian vegetation buffer.	Dependent on option.	Byron Shire Council	Not started
B5	Repair bank stabilisation works along Marshalls Creek at bank erosion site MA05	1	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works	Dependent on option.	Byron Shire Council	Not started
B6	Repair bank stabilisation works along Marshalls Creek at bank erosion site MA07	1	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works	Dependent on option.	Byron Shire Council	Not started
B7	Undertake on-ground works (structural bank stabilisation and revegetation) along Brunswick River at bank erosion site BR03	1	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works 4. Undertake revegetation works to increase riparian vegetation buffer	Dependent on option.	Byron Shire Council	Not started

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	COST	LEAD AGENCY	STATUS
B8	Undertake on-ground works (structural bank stabilisation and revegetation) along Brunswick River at bank erosion site BR08	1	1. Engage landowner to determine willingness to participate 2. Develop concept designs and costing's 3. Prepare detailed designs 4. Undertake bank stabilisation works 5. Undertake revegetation works to increase riparian vegetation buffer	Dependent on option.	Byron Shire Council	Not started
B9	Repair bank stabilisation works along Brunswick River at bank erosion site BR10	1	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works	Dependent on option.	Byron Shire Council	Not started
B10	Monitor erosion along Brunswick River at sites BR02, BR13, BR14, BR15 and BR16	1	1. Undertake site survey and assessment of river 2. Monitor erosion.	Operational	Byron Shire Council	Not started
B11	Undertake on-ground works (structural bank stabilisation / formalise public access / revegetation) along Simpsons Creek at bank erosion site SI07	2	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works 4. Formalise public access 5. Undertake revegetation works to increase riparian vegetation buffer.	Dependent on option.	Department of Industry - Lands	Not started
B12	Undertake on-ground works (revegetation) and monitor erosion along Brunswick River at bank erosion sites BR04 and BR06	2	1. Engage landowner to determine willingness to participate (BR06) 2. Undertake revegetation works to increase riparian vegetation buffer 3. Monitor erosion at site.	Dependent on option.	Byron Shire Council	Not started
B13	Undertake on-ground works (structural bank stabilisation works and revegetation) along Brunswick River at bank erosion site BR07	2	1. Engage landowner to determine willingness to participate 2. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works 4. Undertake works to increase riparian vegetation buffer.	Dependent on option.	Byron Shire Council	Not started
B14	Repair bank stabilisation works along Brunswick River training wall at site BR18	2	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works	Dependent on option.	Department of Industry - Lands	Not started
B15	Undertake on-ground works (revegetation) along Marshalls Creek at sites MA02 and MA03	2	1. Engage landowner to determine willingness to participate 2. Develop concept designs and costing's 3. Prepare detailed designs 4. Undertake revegetation works to increase riparian vegetation buffer.	Dependent on option.	Brunswick Valley Landcare; Byron Shire Council	Not started
B16	Undertake on-ground works (revegetation) and monitor erosion along Brunswick River at bank erosion site BR01 and BR05 Undertake revegetation works to increase riparian vegetation buffer.	3	1. Undertake site survey and assessment of river 2. Engage landowner to determine willingness to participate 3. Monitor erosion 4. Undertake revegetation works to increase riparian vegetation buffer.	Operational	Byron Shire Council	Not started
	ON-GROUND WORKS - Other					
G1	Review and reassess the Main Arm Effluent Reuse Scheme (MERS)	1	1.Undertake a review of the Recycled Water Management Strategy 2. Continue liaising with farmers to identify potential for future upgrades. 3. Reassess the reuse strategy and consider options	\$50,000	Byron Shire Council	Not started

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	COST	LEAD AGENCY	STATUS
G2	Mark significant navigational hazards	1	1. Develop consultation program to obtain details of all existing navigational hazards 2. Undertake consultation program with waterways users and Maritime NSW to identify all navigational hazards. 3. Mark all navigational hazards, including oyster leases, STP outfalls and tree snags.	\$7,500	Roads and Maritime Services	Not started
G3	Work with landholders to revegetate and/or fence the riparian zone along all waterways within the estuary	2	1. Identify priority areas for revegetation and/or fencing within the immediate estuarine catchment using vegetation mapping 2. Review works completed and assess priority riparian areas for revegetation and/or fencing 3. Liaise with landholders to determine willingness to be involved in riparian corridor revegetation and/or fencing within their properties 4. Undertake revegetation and/or fencing of riparian corridors in consultation with landholders 5. Educate landholders and encourage undertaking best practice river bank and riparian restoration works.	Dependent on option.	Byron Shire Council	Not started
G4	Map and eradicate weed infestations by survey, education and weed management programs	3	1. Seek funding through grants and work with local Landcare groups to identify, survey and map areas for abundance and distribution of environmental weeds 2. Identify weed "hotspots" and priority areas for action 3. Target those weeds that pose a social, environmental or economic threat to the catchment values 4. Co-ordinate weed management programs in alignment with the North Coast Regional Strategic Weed Management Plan & Biosecurity Act / Regulations (2015) 5. Remove weeds applying an Integrated Pest Management approach to the manage weeds based first on prevention and when needed, a control (biological, cultural, physical or mechanical intervention). Saving a registered herbicide application as a last resort	\$20,500	Byron Shire Council	Not started
	INVESTIGATION AND RESEARCH					
IR1	Determine current status of recreational and commercial activities and their impact estuary health and user values and develop a guidance document for the sustainable management of commercial activities	1	Part A: 1. Determine environmental and social values of the estuary and establish baseline conditions of estuary health (seagrass beds, mangroves saltmarsh etc)* 2. Undertake a basic impact assessment of recreational and commercial activities on estuary health 3. Undertake a basic impact assessment of recreational and commercial activities on user values of the estuary 4. Determine current status of recreational and commercial activities and their impacts on estuary health and user values 5. Assess different scenarios based on increased activities 6. Establish management actions and measures to ensure the sustainable management of recreational and commercial activities on the health and user values of the Brunswick Estuary Part B: 1. Review outcomes of impact assessment (Part A) and establish assessment criteria for the sustainable management of licences 2. Develop a specific Guidance Document for use by Public Agencies to assess the licencing of existing and future commercial activities 3. Create an Memorandum of Understanding (MOU) between agencies involved in Commercial Activity Licences (Byron Shire Council, Department of industry – Marine Parks and Department of Industry - Lands).	Operational	Byron Shire Council; Department of Primary Industries – Marine Parks; and Department of Industry - Lands	Not started
IR2	Investigate water quality issues in the Capricornia Canal system	1	1. Advise Southern Cross University of post-graduate research project to investigate the water quality issues in the Capricornia Canal system 2. Undertake water quality modelling and any necessary field sampling 3. Write up report on findings and provide to Byron Shire Council for consideration and action	\$12,000	Byron Shire Council	Not started
IR3	Undertake point source sampling at stormwater outfalls adjacent to the Mills Street Industrial Area, the former Brunswick Heads Tip site and the marina to determine potential sources of trace metal and chemical toxin input to the estuary	1	1. Undertake point source sampling at stormwater outfalls adjacent to the Mills Street industrial area and the marina to determine presence of trace metal discharges (particularly lead and copper) in stormwater discharge 2. Identify those industries that may produce trace metals as a by-product of their operations or whether there are pre-1970s painted buildings within the complex 3. Issue warning letters and/or penalty notices to non-compliant businesses / activities 4. Distribute industry-specific information brochures (such as EPA guidance) to all businesses to encourage "Cleaner Production". 5. Introduce rewards and issue penalties for best and unacceptable practices respectively. 6. Undertake point source sampling one month after warning letters / penalty notices have been issued	\$4,200	Byron Shire Council	Not started
IR4	Undertake benthic habitat mapping of ecosystems present in the Brunswick Estuary to provide baseline of current extent of ecosystems	2	1. Advise Southern Cross University of research project in the Brunswick Estuary 2. Undertake benthic habitat mapping of seagrass, mangrove and saltmarsh communities in the Brunswick River (based on the methods used by DPI and the most recent mapping completed) 3. Write up report on findings and provide to Byron Shire Council for consideration 4. Use results for consideration of other research activities to improve the health of ecosystems in the Brunswick Estuary 5. Habitat mapping to compliment and assist in interpretation of the results of the Ecohealth Program (M1).	\$15,000	Byron Shire Council and DPI – Fisheries	Not started

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	COST	LEAD AGENCY	STATUS
IR5	Undertake drain mapping within the north and south of the Brunswick River and Marshalls Creek sub-catchments	2	1. Review 1:25,000 aerial photographs to determine locations of existing drainage, including landholder drains and union drains 2. Devise code for depth, width and height of spoil mound to the nearest 1metre 3. Undertake ground truthing to confirm existing, length, width and depth of drains 4. Develop GIS layer detailing locations and characteristics (width, depth and spoil height) of drainage within the Marshalls Creek sub-catchment area	\$17,500	Byron Shire Council	Not started
IR6	Undertake a soil survey of PASS along Marshalls Creek, Simpsons Creek and the Brunswick River	2	1. Undertake a detailed topographical survey of those areas identified by the OEH Acid Sulfate Soil Risk Maps as areas of PASS 2. Identify those areas less than 5m AHD 3. Undertake a field and vegetation survey of low-lying areas to determine presence of acid scalds, iron staining, jarosite and death of vegetation 4. Determine borehole locations for soil sampling 5. Undertake soil sampling 6. Develop GIS layer to be used by Council staff when assessing development applications, etc. 7. Data to be used in development of an Acid Sulfate Soils Management Plan (Refer to P5).	\$26,500	Byron Shire Council	Not started
IR7	Conduct audit of all weirs and pumps on all stream catchments within the Brunswick Estuary to obtain an accurate assessment of their numbers, locations and impacts	3	1. Obtain DPI records on all pumps within the Brunswick Estuary 2. Identify all weirs, pumps and water extractions within the estuary using DPI records and previous studies 3. Audit all structures by boat and by foot (as necessary) using a GPS system to record their location 4. Identify those having the greatest impact on catchment flows, fish migration and infiltration 5. Determine potential management actions / options for reducing the impact of existing structures on catchment flows and infiltration. 6. Consult with community on proposed management actions. 7. Undertake improvement / modification works. 8. Monitor flows to assess effectiveness of modified structures - this may be achieved by integrating with existing Landcare programs to estimate stream flows in the catchment.	\$5,500	Byron Shire Council	Not started
IR8	Assess the distribution and abundance of fish stocks in the Brunswick Estuary	3	1. Advise Southern Cross University of research project initiative 2. Develop research question 3. Undertake survey of fish abundance within the Brunswick River 4. Collate information and report on fish abundance 5. Undertake survey of fish abundance in three to five years' time to determine any changes in species or distribution 6. Undertake management actions as necessary to control recreational fishing.	\$18,000	Department of Primary Industries - Fisheries	Not started
	MONITORING					
M1	Develop and implement the Northern Rivers Ecosystem Health Monitoring Program (Ecohealth) in the Brunswick Estuary reporting on the estuarine and freshwater health of the waterway	1	1. Prepare media release advising community of the plan to establish water quality and ecosystem monitoring within the Brunswick Estuary (and other areas in the Byron LGA if applicable) 2. Develop and implement the Ecohealth Program (as part of the North Coast Bioregion Ecohealth Program) using sampling protocols and analysis developed by OEH and the University of New England. 3. Undertake field sampling of ecohealth indicators at required intervals (annually) 4. Report on water quality and ecohealth indicators in regular 4 yearly report cards and the Byron Shire Council website, State of the Environment Report and local media.	\$18,000*	Byron Shire Council	Not started
	EDUCATION AND PUBLIC RELATIONS					
E1	Educate Council planners on the impacts of planning decisions on estuary processes & water quality	1	1. Develop a council staff education program that outlines the importance of estuary processes and the potentially adverse impacts of development (i.e.: untreated and uncontrolled stormwater runoff, clearing of vegetation, sedimentation etc.) 2. Undertake two one day workshops with Council planning staff and external consultants	\$1,500	Byron Shire Council	Not started
E2	Prepare and undertake a targeted education program for rural property owners to make them aware of best practice catchment management	1	1. Publish a media article inviting all rural property owners to workshops 2. Undertake workshops for rural property owners at local community hall 3. Distribute industry-specific education brochures to all landholders.	\$2,000	Byron Shire Council and Brunswick Valley Landcare	Not started
E3	Develop a community education program that outlines the importance of estuary processes and the impacts of human activities on estuary processes	1	1. Develop a community education program that outlines the importance of estuary processes and the potentially adverse impacts of human activities (i.e.: untreated and uncontrolled stormwater runoff, clearing of vegetation) 2. Develop and distribute a global brochure aimed at the whole community describing issues facing the estuary. 3. Develop and distribute targeted brochures to selected community groups and estuary users (e.g. residents, tourists, recreational fishers) outlining potentially adverse impacts. 4. Organise media coverage of on-the-ground works as they are carried out and achievements in the implementation of this CZMP.	\$12,000	Byron Shire Council	Not started

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APPENDICES