

Rous County Council

Catchment Management Plan 2021-2025



Final Report

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Cover photo: Healthy waterway of Upper Wilsons Creek, headwaters of the Wilsons River Source

Hydrosphere Consulting Pty Ltd
Suite 6, 26-54 River Street
PO Box 7059, BALLINA NSW 2478
www.hydrosphere.com.au

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19-047: ROUS CATCHMENT MANAGEMENT PLAN

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1. INTRODUCTION

Rous County Council (RCC) provides bulk water to four local water utilities on the far north coast of NSW as well as rural and urban connections direct from the bulk supply trunk main system. Surface water is sourced from three supplies at Rocky Creek Dam (RCD), Wilsons River Source (WRS) and Emigrant Creek Dam (ECD).

The purpose of this Catchment Management Plan (CMP) is to set the strategy for the coordinated management of RCC's drinking water catchments for the next 5 years (2021-2025). This CMP fulfils the requirements of the Australian Drinking Water Guidelines (ADWG, NHMRC, NRMCC, 2011) from catchments to the offtake points for water supplies as a critical part of the overall RCC Drinking Water Management System (RCC, 2018).

This CMP replaces the previous catchment management plans for Rocky Creek Dam, Emigrant Creek Dam and Wilsons River Source. The key focus of this CMP is to minimise the introduction of hazards in source water by maintaining and strengthening the existing catchment controls and providing additional tasks to manage catchment risks.

If source water is of a high quality, risks are reduced in all later stages of drinking water supply. Good quality source water requires less complex treatment systems, less chemical additions and reduced cost and energy consumption through treatment processes.

This CMP incorporates management actions to address key risks to drinking water quality. The recommended management actions are logical outcomes of the existing information collected, the current status of catchments and catchment risks, input from key stakeholders and consideration of the current allocation of resources and funding. The CMP has been developed in three stages as follows:

- Stage 1: Status of Existing RCC Catchment Management Plan (CMP) Actions – a review of the current status of existing CMP actions (refer Appendix 1);
- Stage 2: RCC Drinking Water Catchments Risk Assessment 2020 - update of catchment risk assessments for each catchment taking into consideration the CMP actions already undertaken and any relevant changes in land use, risk factors and the planning environment (refer Appendix 2); and
- Stage 3: Catchment Management Plan 2021-2025 (this report) - a targeted plan for the coordinated management of RCC's drinking water catchments for the next 5 years (2021-2025).

Implementation plans for the three operational drinking water catchments, RCD, WRS and ECD focus on drinking water management. The Dunoon Dam (DD) plan has a strategic focus on land management for land owned by RCC in that catchment.

This CMP focuses on those actions under the direct control of RCC, although RCC will continue to work with catchment stakeholders and collaborate wherever management responsibilities are shared. This CMP sets a clear division of responsibilities between RCC and other stakeholders and provides a formal process around how RCC will continue to engage with stakeholders for effective management of drinking water catchments.

The CMP will allow RCC to confirm budget requirements through the Integrated Planning and Reporting (IP&R) framework, and will also increase the likelihood of attracting grant funding by allowing RCC to leverage the identified projects and by supporting funding applications.

2. BACKGROUND TO THE CATCHMENT MANAGEMENT PLAN

2.1 Water Supply System Overview

The RCC bulk water supply system supplies water to approximately 100,000 people (51,000 connections) in the Byron, Ballina, Lismore and Richmond Valley Local Government Areas (LGAs). The bulk supply network services supplies on average 11,700 ML/a to the urban areas of Ballina Shire Council (BSC) excluding Wardell and surrounds, Byron Shire Council (BySC) excluding Mullumbimby, Lismore City Council (LCC) excluding Nimbin, Richmond Valley Council (RVC) excluding Casino and all land west of Coraki and rural and urban connections direct from the bulk supply trunk main system.

RCD is the principal source of water for the RCC regional supply and is supplemented by ECD, the WRS and several bore sites in Alstonville and Woodburn. These additional sources are brought on-line as the storage level in RCD drops to help secure the water supply and avoid water restrictions. Detailed information on the drinking water catchments is provided in Section 3.

Figure 1 provides an overview of RCC's current surface water drinking catchments of RCD, ECD and WRS. It also shows the Dunoon Dam (DD) catchment, a potential future surface water source, which does not form part of the current supply system.

RCC's drinking water catchments span the three local government areas of Lismore, Byron and Ballina. Figure 2 shows the division of catchments into the three different LGAs as follows:

- RCD – Lismore LGA
- WRS – Lismore, Byron and Ballina LGAs
- ECD – Ballina LGA
- DD – Lismore LGA

The following sections provide an overview of the current status of each catchment including land use, water quality and details of water extraction and treatment.

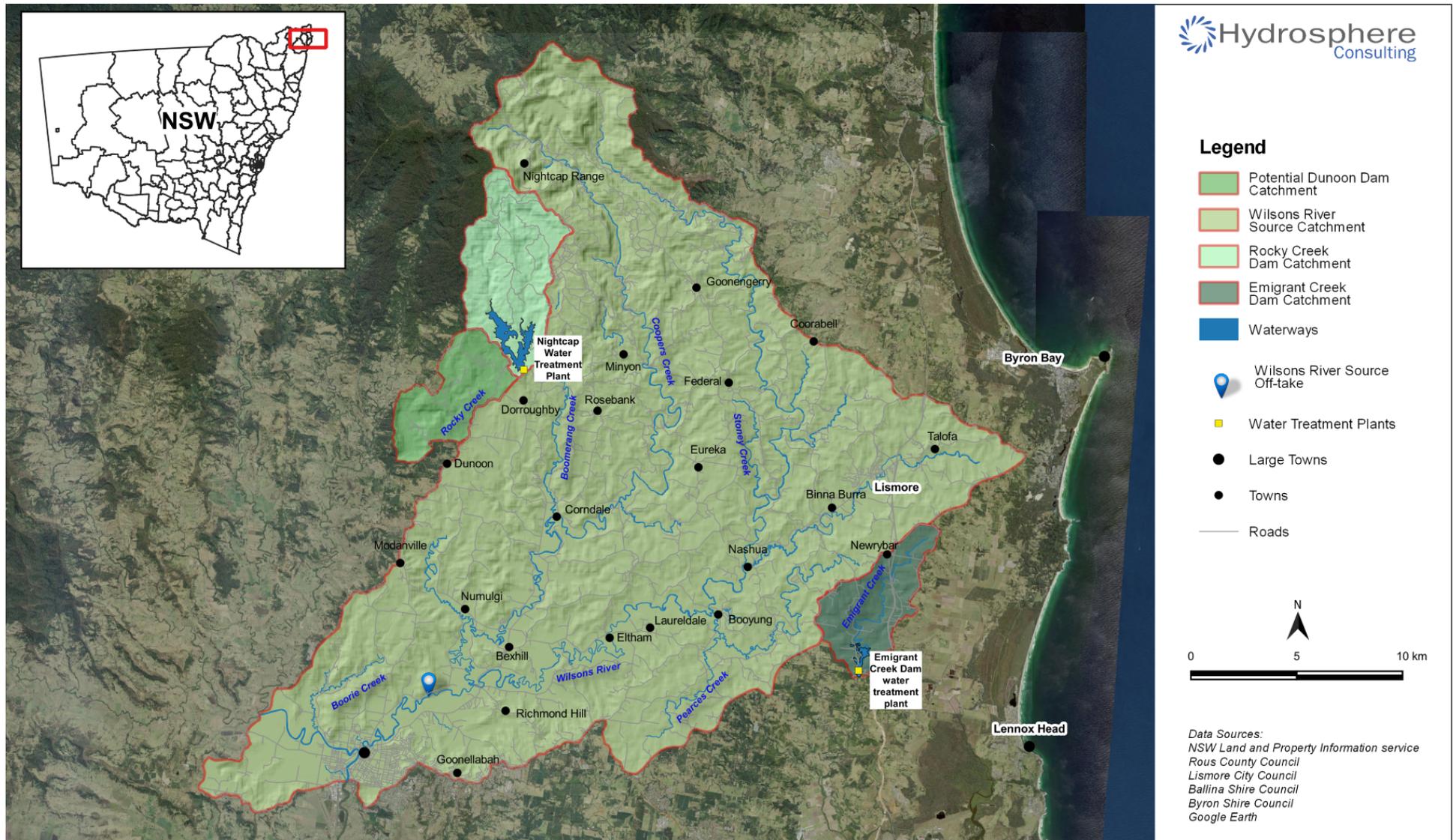


Figure 1: RCC's surface water catchments: Rocky Creek Dam, Emigrant Creek Dam and Wilsons River Source and potential Dunoon Dam

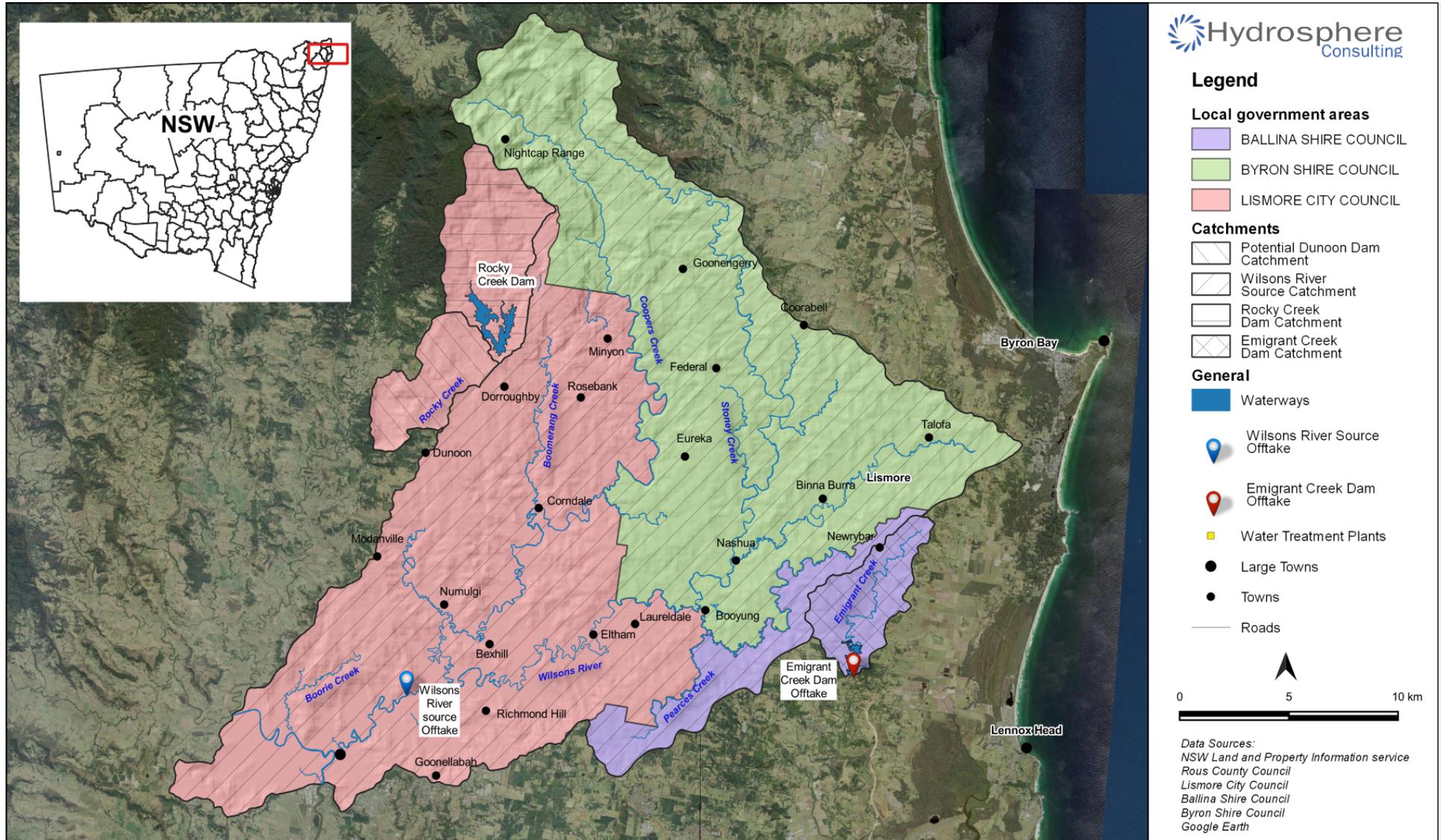


Figure 2: Division of catchments into local government areas

2.2 The Australian Drinking Water Guidelines and Catchment Management

The Australian Drinking Water Guidelines (ADWG; NHMRC, NRMCC, 2011) emphasise the importance of protecting water sources (catchments) and provide a number of overarching principles for catchment management, including: "*prevention of contamination provides greater surety than removal of contaminants by treatment, so the most effective barrier is protection of source waters to the maximum degree practical.*"

RCC is required to comply with the ADWG which include the "Framework for Management of Drinking Water Quality" that emphasises:

- Multiple barriers are required to protect drinking water quality;
- The most effective barrier is the protection of source waters;
- Source waters should be protected to the maximum degree practical;
- Water quality should be maintained at the highest practicable quality; and
- Water quality should not be degraded even if it complies with guideline values by a safe margin.

2.2.1 RCC Drinking Water Management System

RCC has developed a Drinking Water Management System (DWMS) that fulfils the requirements of the ADWG (RCC, 2018). The RCC DWMS addresses risks from the receiving point in the catchment (offtake points for water supplies) to the customer tap. A critical part of the DWMS is the assessment of catchment water quality, catchment hazard identification, risk assessment and specification of control measures. This CMP (including risk assessments) fully implements the requirements of the ADWG as part of the overall RCC DWMS from catchments to the offtake points for water supplies.

2.3 RCC Drinking Water Quality Monitoring Program

RCC carries out regular testing of both source (raw) water and treated drinking water as one of the key measures to help ensure a safe drinking water supply. Extensive sampling and analysis is carried out by accredited NATA laboratories to confirm compliance with agreed targets, to assess raw water quality and identify sources of contamination or changes through time, provide data to inform long term treatment effectiveness and for quality assurance of testing by treatment plant operators. Comprehensive analysis and interpretation of water quality data is undertaken periodically and was last completed in 2015 (Hydrosphere Consulting, 2015). Further analysis of the last five years of water quality data (2015-2019) was undertaken as part of the Stage 2 Risk Assessment to update and review water quality risks (Appendix 2).

2.4 Previous Catchment Management Plans and Risk Assessments

2.4.1 Wilsons River Catchment Management Plan (Ecos, 2009a)

This CMP is a risk-based catchment and investment strategy to direct activities aimed at protecting drinking water quality at the WRS and an environmental monitoring program to underpin the on-going adaptive management of the water source catchment. Ecos (2009b) completed a detailed modelling and mapping-based risk assessment across 12 sub-catchments in consultation with a broad range of stakeholders. The risk assessment identified a range of risks associated with agricultural and urban land use and provided spatially referenced (mapped) risk scores across the catchment in a number of categories (e.g. sediment, nutrients, pathogens, pesticides etc.). In general, the greatest risks from diffuse pollutant sources were derived from the lower catchment close to the WRS offtake at Howards Grass and risk decreased with distance from the offtake (Figure 3). This identified the lower catchment close to the WRS offtake as a priority zone for management.

A key purpose of the CMP was to identify opportunities for the various stakeholders in the catchment to work together for positive outcomes for the catchment, water supply, and participants. To meet the guiding principles, key outcome areas (KOAs), management programs and plans were identified, each with associated goals and aims. The four KOAs are:

1. Environmental Management.
2. Agronomic Land Management Practices.
3. Management of Built Environments.
4. Governance.

The CMP contained a detailed list of 98 actions for implementation in a number of categories to address risks. The review of the status of actions of the 2009 CMP completed as part of Stage 1 of this CMP project, revealed that a number of actions were complete and on-going as part of River Reach Plan on-ground works in the lower catchment, planning and policy review and RCC normal operations and engagement activities. However, many actions were assessed as incomplete or unknown due to those actions being the responsibility of other authorities, organisations and/or landholders and therefore outside of the direct control of RCC (Appendix 1). Focusing management action in areas under the direct control of RCC is a key requirement for this CMP.

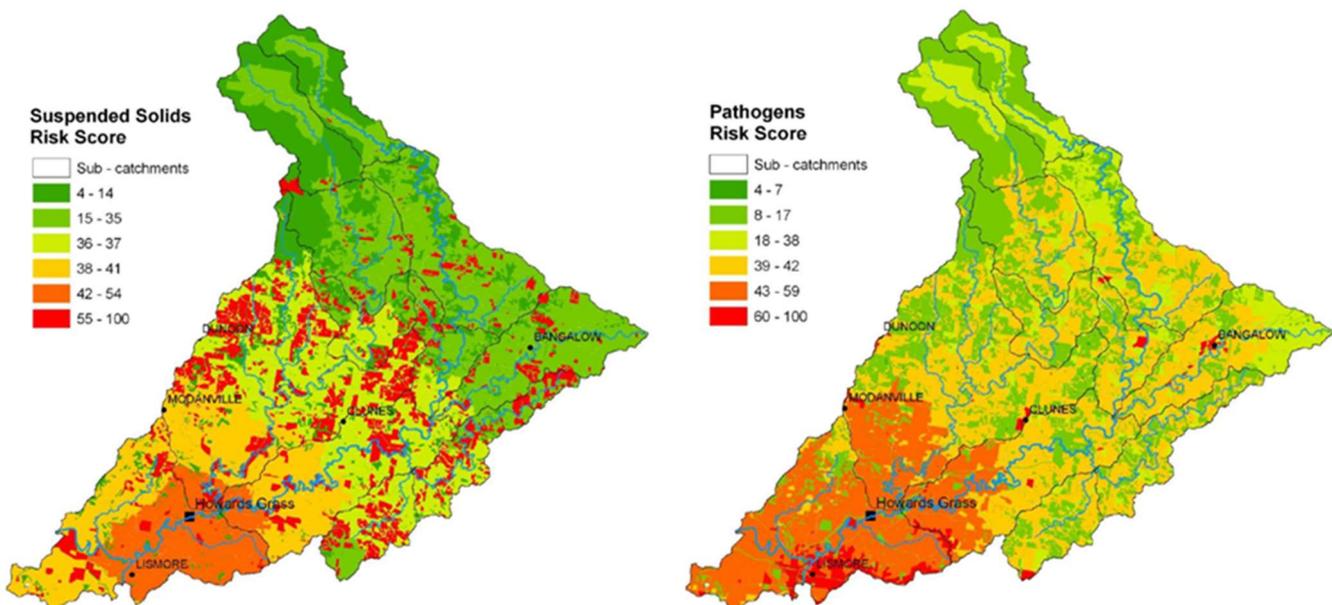


Figure 3: Wilsons River catchment risk scores (Left: suspended soils; Right: pathogens)

Source: Ecos, 2009b

Catchment Management Plan for Emigrant Creek Catchment (Water Futures, 2013)

The CMP covers the “catchment to treatment plant” component of the water supply system. It fed into the more engineering-focused “treatment plant to tap” management plan being implemented by RCC and its constituent councils. Together, these management plans form the DWMS that is required under the *Public Health Act 2010*.

The vision for the catchment stated in the CMP is: “a healthy, productive catchment with fully functioning ecosystems that produces clean water”.

The following stages were completed in developing the CMP:

- Preparing a written description of the catchment and source water.

- Setting water quality objectives for raw drinking water and ecosystem health.
- Assessing source water quality against those water quality objectives.
- Assessing risks to water quality with the catchment in its current state.
- Identifying future actions for RCC and stakeholders to reduce risks.

A series of management actions were identified and allocated to RCC and other stakeholders to reduce residual risks associated with Hazmat spills on roads, road construction runoff, unrestricted stock grazing, failing on-site sewage management systems, fertiliser runoff, agricultural soil erosion runoff and natural manganese (Water Futures, 2013).

The review of the status of actions of the 2013 CMP completed as part of Stage 1 of this CMP project revealed that a number of actions were complete and on-going as part of River Reach Plan on-ground works in reaches immediately upstream of the dam, planning and policy review and RCC normal operations and engagement activities. However as noted for the Wilsons River CMP, many actions were assessed as incomplete or unknown due to those actions being outside of the direct control of RCC (Appendix 1). There was also a number of incomplete actions associated with stock management (e.g. fencing, stock crossings, off-stream watering etc.) due to a lack of River Reach Plan up-take with grazing landholders. Additionally, collaborative actions with the Australian Macadamia Society (AMS) to produce farm-based erosion management plans to address sediment export were incomplete due to RCC resolving not to pursue this at that time. Given the continuing risk to drinking water associated with stock waterway access and sediment export from macadamia farms, these are key areas for future management as part of this CMP.

2.4.2 Rocky Creek Dam Catchment Management Plan (Deere *et al.*, 2015)

The CMP follows a similar format to the Emigrant Creek CMP (Water Futures, 2013) covering the “catchment to treatment plant” component of the RCC water supply system.

The CMP describes the Rocky Creek Dam catchment as having no high-risk land uses or significant point pollution sources. Risks to water quality both now and in the future were identified as roads and recreational activities within the catchment and longer-term potential for the catchment to be degraded by development.

The focus of management for the catchment is on maintaining and protecting the catchment and water quality for the long term and preserving the undeveloped nature of the catchment. Review of the status of actions of the 2015 CMP completed as part of Stage 1, indicated that the majority of CMP actions are complete and on-going as part of normal RCC operating procedures involving effective collaboration with National Parks and Wildlife Service (NPWS) and other stakeholders (LCC, NSW Environmental Protection Authority - EPA, Rural Fire Service -RFS etc.). Bushfire management and assessing post-bushfire water quality risk was identified as an area requiring review and update in consultation with NPWS following the 2019 bushfires in the catchment (Appendix 1).

2.4.3 Pesticide Risk Assessment (under review)

RCC periodically reviews changing pesticide use in the catchments to ensure the effectiveness of the water testing program to ensure that the treatment of water delivers safe drinking water for the region’s residents. Previous reviews of the suitability of the water testing program, in terms of pesticide risk to drinking water, were undertaken over ten years ago. Since the previous reviews, there have been significant changes to land uses in the study area, and substantial changes to pesticide usage by varying land uses associated with increased understanding and uptake of integrated pest management, but also as a result of bans on the sale and use of previously popular insecticides such as endosulfan.

A review of the pesticide risk assessment has considered:

- Updated land use mapping.

- Stakeholder and industry consultation, and literature review to identify pesticide type, usage and pesticide properties.
- Derivation of risk of pesticide usage within the catchments associated with usage, pesticide properties and environmental characteristics such as slope, precipitation, soil type, erosivity and proximity to watercourses.
- Review of the suitability of RCC's pesticide monitoring program.
- Examination of alternative monitoring methods.
- Design of an intensive sampling program for future sampling.

This CMP refers to the updated pesticide risk assessment for catchment risks covered by that study.

2.5 Development of the Catchment Management Plan

2.5.1 Stage 1: Status of Existing RCC Catchment Management Plan (CMP) Actions

The initial stage of CMP development involved a detailed audit of previous Rous County Council (RCC) drinking water catchment management plans. The relevant management plans audited were:

- *Catchment Management Plan for Emigrant Creek Dam Catchment* (Acret et al., 2013).
- *Catchment Management Plan for Rocky Creek Dam Catchment* (Deere et al., 2015).
- *Wilson's River Catchment Management Plan* (Ecos Environmental, 2009).
- *Dunoon Dam Buffer Zone Strategic Plan* (Hydrosphere Consulting, 2009).

The status of the previous management actions documented in the above plans was compiled through review of background documentation, GIS mapping of catchment works and consultation with RCC staff including a workshop and follow up with the RCC natural resource management project team. A description of the actions implemented to date was provided along with discussion of past successes and failures and recommendations for future work to be considered in the development of this CMP. The *Status of Existing RCC Catchment Management Plan (CMP) Actions* report is provided as Appendix 1 of this CMP.

2.5.2 Stage 2 : RCC Catchment Drinking Water Risk Assessment 2020

Catchment Risk Assessments for each RCC drinking water source were updated based on background information, current knowledge and stakeholder consultation. Risk assessment workshops were held with key stakeholders to assist in the update of catchment information and current risk factors. The workshops were catchment specific, with four separate workshops held over two days on 23rd and 24th October 2019.

For each catchment (where applicable), hazard/hazardous event combinations were assessed across a number of catchment themes including on-site sewerage management, urban stormwater and sewage management, livestock, horticulture, contamination (e.g. spills, malicious events and contaminated land), roads, recreation, wildlife, natural geology and bushfire. For each identified hazard or hazardous event, the level of risk to drinking water supply was estimated to allow for prioritisation of risk and determination of any necessary additional management actions required to minimise risk to drinking water quality. The risk assessments are provided as Appendix 2 of this CMP.

3. RCC DRINKING WATER CATCHMENTS

This section describes the catchments and water sources from which RCC extracts raw water. It provides a snapshot of the broad risks to source water assessed as part of the Stage 2 Catchment Risk Assessment (Appendix 2) and current catchment management activities employed to manage risk.

3.1 Rocky Creek Dam Catchment

3.1.1 Catchment Description

The RCD catchment is located approximately 20km north of Lismore and covers an area of approximately 31km². The catchment is dominated by largely pristine forest protected within the Nightcap National Park and Whian Whian State Conservation Area, which together make up 85% of the catchment area (Figure 4). These areas are managed by the National Parks and Wildlife Service (NPWS). RCC also owns and manages a large area of land at the RCD reserve and has successfully established large areas of subtropical rainforest buffer zones around the dam comprising 7% of the catchment area. The remaining catchment is made up of the RCD waterbody (7.6%) and the water treatment plant (WTP) and associated infrastructure (0.3%).

3.1.2 Snapshot of Issues

There are no significant point or diffuse sources of pollution in the catchment. There are some minor access roads and recreational activities within the catchment associated with the National Park areas and the Rocky Creek Dam reserve. Key potential sources of risk to raw drinking water quality are summarised as:

- Recreational use – human waste enters watercourse from recreational activities (e.g. swimming) carrying harmful microbial pathogens.
- Wildlife - faecal matter from animals and birds contaminates water - including waterbirds perching on the offtake tower and horses which are permitted on parts of the road and trail network within the catchment.
- Roads - general road runoff (e.g. sediment, fuels, oils, brake fluids etc.).
- Bushfire – major bushfire occurs in the catchment followed closely by significant rainfall which transports pollutants (e.g. sediment, nutrients, organic matter, ash, metals and toxins) to the raw water supply.
- Hazmat spills - chemical spill enters watercourse/dam after truck/tanker road accident or during deliveries and unloading at the WTP.
- Malicious contamination - dangerous chemicals are deliberately placed in source water.
- Natural soils/geology - elevated iron and manganese exceed ADWGs due to naturally occurring soil/geology.

These potential risks were assessed as part of the risk assessment process considering the current management actions undertaken as outlined below.

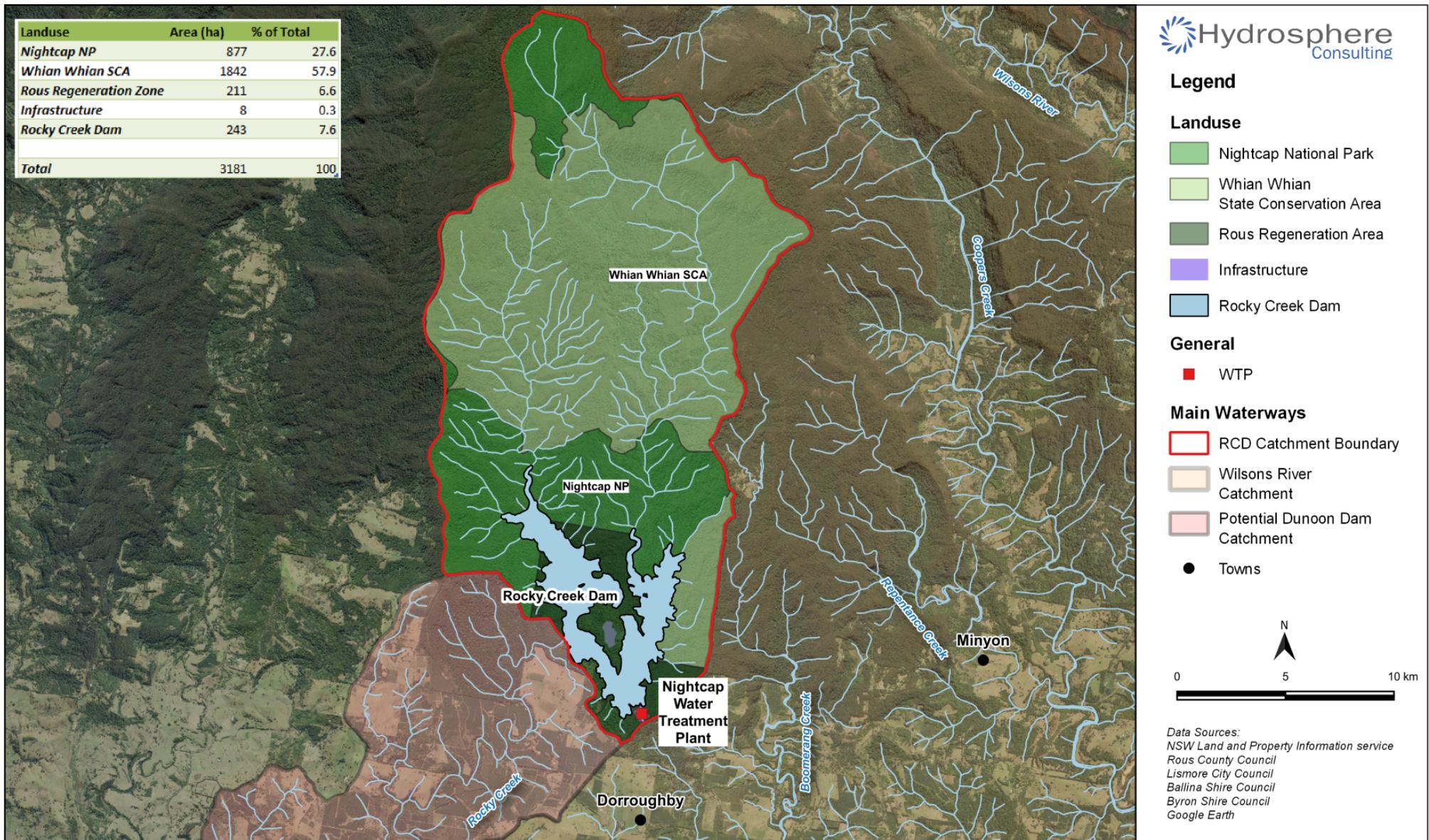


Figure 4: Rocky Creek Dam catchment land use

3.1.3 Current Management

The review of management actions currently in place to control known water quality risks in the RCD catchment was undertaken as part of Stage 1 (Appendix 1). Catchment management measures for RCD include:

- NPWS management of the majority of catchment areas contained within Nightcap National Park and Whian Whian State Conservation Area in accordance with NPWS Plans of Management including land stabilisation works, fire detection and response, recreational trail maintenance, management trails maintenance and feral animal control.
- Regular communications between RCC and NPWS to renew/update the Memorandum of Understanding (MOU) between NPWS and RCC for management and maintenance of land.
- Drinking water catchment signage at key locations to inform the public and provide call centre number to report spills etc.
- Limitations on human access (signage, very few roads, no access to watercourses, inspection and enforcement).
- On-going RCC and NPWS catchment surveillance activities.
- On-going fire detection and response by RCC and NPWS. Fire planning reviewed and updated annually by NPWS.
- Vegetated buffer zone along dam and watercourses maintained and enhanced.
- The use of herbicides within the catchment area by RCC or NPWS with strict adherence to best practice regulations. Chemical certification required for all RCC and NPWS contractors.
- Regular inspections and maintenance of the on-site sewage management (OSSM) system at the WTP.
- Hazmat spill response including capture, bunding and removal of contaminants. Option to shut off the plant whilst Hazmat experts assist with clean-up.
- Nightcap WTP stormwater drains have containment bunds and storage basins. Delivery and storage procedures are generally in accordance with regulations and on-going improvements are being planned and implemented. Incident response protocols in place under the RCC DWMS.
- Reservoir management undertaken by RCC in accordance with the RCC DWMS. The dam has a de-stratification (aeration) system which reduces conditions favoured by blue green algae and prevents the bottom of the dam becoming anaerobic.

Nightcap WTP treats water extracted from the dam before supply to RCC customers. Section 3.4.3 provides further details of the WTP and processes.

3.1.4 Risk Assessment Outcomes

The risk assessment undertaken as part of Stage 2 updated catchment risk levels and assessed the effectiveness of management actions currently in place. Table 1 summarises the high priority risks identified through the catchment risk assessment process. Refer Appendix 1 for full results.

Table 1: High priority risks to drinking water in the RCD catchment

Hazard type	Hazard	Source	Hazardous event
Biological	Bacteria, Protozoa and Viruses	Native and introduced wildlife	Faecal matter from animals and birds contaminates water – including waterbirds perching on the offtake tower.
Chemical	Iron	Natural geology	Iron concentrations exceed ADWGs in source water and cause aesthetic problems in water. This is likely to be due to naturally occurring soil/geology.
	Toxins (unknown contaminant)	Hazmat spills	Chemical spill enters watercourse after truck/tanker road accident or spill during delivery to WTP.
		Malicious contamination	Dangerous chemicals are deliberately placed in source water
		Bushfire	Major bushfire occurs in catchment and is followed closely by significant rainfall which transports pollutants (e.g. nutrients, organic matter, ash, metals and toxins) to raw water supply.
	Firefighting foams/retardants ¹	Bushfire response leading to foams and chemical runoff. Also risk of nutrients from phosphate based fire retardants if used.	
Physical	Turbidity	Bushfire	Major bushfire occurs in catchment and is followed closely by significant rainfall which transports large amounts of sediment and ash to raw water supply.

1. Discussions with NPWS have indicated that firefighting foams and retardants are not used within National Park in the drinking water catchment areas, however the risk assessment took the precautionary approach and considered that use may occur in extreme circumstances and thus was assessed as a medium risk. However during the 2019 bushfire season fire retardants were used in the vicinity of the Nightcap WTP as a precaution to protect this asset during catastrophic fire danger conditions.

3.2 Wilsons River Source Catchment

3.2.1 Catchment Description

The WRS pumps water directly from the tidal pool of the Wilsons River approximately 5km upstream from Lismore (at Howards Grass). The catchment area exceeds 566km² and stretches from Upper Wilsons Creek and Upper Coopers Creek in the north to Byron Creek in the east (near Bangalow).

The dominant land use within the catchment is cattle grazing, comprising approximately 57% of the catchment (Figure 5). Horticultural activities comprise approximately 11% of the catchment and include macadamia, avocado, stone fruit, coffee plantations and other mixed horticultural crops. Run-off from the WRS catchment produces water with a high level of nutrient and sediment (Hydrosphere Consulting, 2015), particularly when the flow rates are either very high (in flood) or very low (in drought).

Urban stormwater and wastewater management also have the potential to affect raw water quality. There are over 3,555 OSSM systems in the catchment and approximately 20% of these have been assessed as high risk due to proximity to waterways and the WRS offtake (Ecos, 2009). The extraction point draws from the upper reaches of the tidal pool and is therefore subject to potential movement of water and contaminants from downstream of the intake, and impacts originating upstream within the Wilsons River and Coopers Creek catchments. These include water quality impacts associated with the major urban areas of Lismore and Bangalow both with treated sewage effluent discharge to waterways and stormwater networks (Figure 5). The WRS consists of a pump station abstracting up to 30ML/day of water (an average annual volume of 3,400ML) from the upper reaches of the tidal pool in the Wilsons River. Following abstraction, water is pumped 20km directly to Nightcap WTP for treatment and subsequent supply to consumers through existing water distribution infrastructure. The abstraction is subject to a licence issued by the NSW Government that regulates the circumstances under which the WRS can be operated.

3.2.2 Snapshot of Issues

The WRS catchment is an 'open catchment' meaning that the majority of the catchment area is in private ownership, with unrestricted access to the catchment (Ecos, 2009). The key risks to water quality were identified as:

- Runoff from urban land (e.g. stormwater pollution and sewer overflows).
- Runoff from agriculture (e.g. sediment, nutrient and pathogens etc.).
- Direct stock access to waterways.
- Stream bank erosion and slumping.
- Poor riparian vegetation.
- On-site wastewater disposal (e.g. septic tanks).
- Contaminated land and dip sites.
- Roads – general road runoff (e.g. sediment, fuels, oils, tyres, brake fluids etc.)
- Hazmat spills – chemical spill enters watercourse/dam after truck/tanker road accident or industrial accident.
- Malicious contamination – dangerous chemicals are deliberately placed in source water.
- Natural soils/geology – elevated iron and manganese exceed ADWGs due to naturally occurring soil/geology.

These potential risks were assessed as part of the risk assessment process considering the current management undertaken as outlined below.

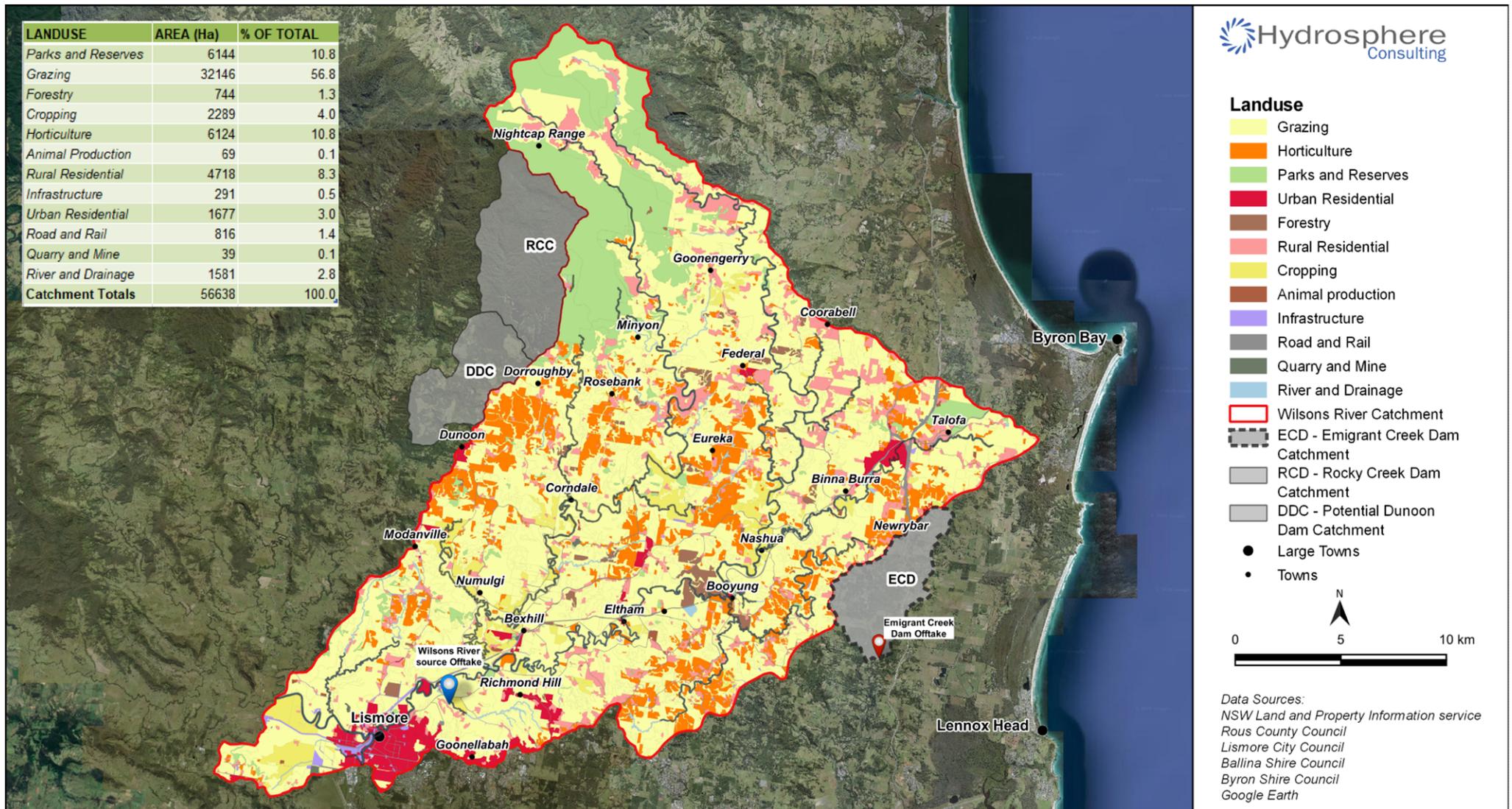


Figure 5: Wilsons River Source catchment land use

3.2.3 Current Management

The review of management actions currently in place to control known water quality risks in the WRS catchment was undertaken as part of Stage 1 (Appendix 1). Catchment management measures for WRS include:

- Drinking water catchment signage at key locations to inform the public and provide call centre number to report spills etc.
- On-going RCC catchment surveillance activities.
- Hazmat spill response including capture, bund, and removal of contaminants by first responders (e.g. RFS, NSW Fire and Rescue). RCC notification of incident by EPA to allow adaptive management and verification testing as necessary.
- Local council planning controls and regulation of OSSM systems.
- Stormwater management and improvement by local councils.
- River Reach Plans in the lower catchment in the vicinity of the WRS offtake including establishment of vegetated buffer zones, off-stream watering and fencing.
- RCC buffer zone establishment in the vicinity of the WRS offtake.
- On-going fire detection and response.
- In addition to these catchment controls there are turbidity limits on water extraction from the Wilsons River Source due to interference with treatment processes at Nightcap WTP.

Nightcap WTP treats water extracted from the WRS before supply to RCC customers. Section 3.4.3 provides further details of the WTP and processes.

3.2.4 Risk Assessment Outcomes

The risk assessment undertaken as part of Stage 2 updated catchment risk levels and assessed the effectiveness of management actions currently in place. Table 2 summarises the high priority risks identified through the catchment risk assessment process. Refer Appendix 1 for full results.

Table 2: High priority risks to drinking water in the WRS catchment

Hazard type	Hazard	Source	Hazardous event
Biological	Bacteria, Protozoa and Viruses	OSSM systems	Poor condition or poorly designed/constructed/ situated OSSM systems discharging harmful microbial pathogens to source water.
		Urban sewage	Human faecal matter from leaking sewage pipes discharging harmful microbial pathogens to source water.
		Livestock access to waterways	Livestock faeces directly entering waterways discharging harmful microbial pathogens to source water.

Hazard type	Hazard	Source	Hazardous event	
Chemical	Iron	Natural geology	Iron concentrations exceed ADWGs in source water and cause aesthetic problems in water. This is likely to be due to naturally occurring soil/geology.	
	Hydrocarbons	Hazmat spills	Fuel spill enters watercourse after vehicle road accident.	
	Pharmaceuticals and EDCs	OSSM systems	Poor condition or poorly designed/constructed/ situated OSSM systems discharging effluent containing endocrine disruptors (e.g. hormones both natural and synthetic, pesticides etc.) or pharmaceuticals enters source water	
		Livestock access to waterways	Excretion of veterinary products enters source water	
	Toxins (unknown contaminant)	Hazmat spills	Chemical spill enters watercourse after truck/tanker road accident or spill during delivery to WTP.	
		Malicious contamination	Dangerous chemicals are deliberately placed in source water.	
		Bushfire	Major bushfire occurs in catchment and is followed closely by significant rainfall which transports pollutants (e.g. nutrients, organic matter, ash, metals and toxins) to raw water supply.	
		Firefighting foams/ retardants	Bushfire response leading to foams and chemical runoff. Also risk of nutrients from phosphate based fire retardants if used	
	Physical	Taste and Odour	Suspended solids	Concentrations exceed ADWGs in source water causes aesthetic water quality issues
			Algae	
Turbidity		Stormwater	Urban development effects, such as increased hard surfaces and construction practices, leading to erosion and sediment transport during storm events leading to turbidity that may exceed ADWGs or treatment capacity.	
		Road run-off	Runoff from unsealed roads enters source water carrying sediments and nutrients	
		Bank erosion	Erosion of stream bed and bank mobilising sediments.	
		Agricultural run-off	Runoff from areas of exposed soil enters watercourses carrying sediments.	
Livestock	Runoff from grazing land with elevated turbidity enters source water.			

3.3 Emigrant Creek Dam Catchment

3.3.1 Catchment Description

The ECD catchment is located between Tintenbar and Knockrow, east of the Pacific Highway and north of the village of Newrybar. Emigrant Creek is a tributary of the lower parts of the Richmond River which has its estuary at Ballina.

The catchment covers an area of 19km² and is dominated by agricultural activities with rural residential and some tourist development, and the Pacific Highway. Macadamia farms make up the majority of horticultural land (45% of catchment) with some areas of stone fruit orchards, coffee and banana plantations, and small-scale vegetable growing. Cattle grazing comprises approximately 32% of the catchment, rural residential properties make up 12% of the catchment and roads including the Pacific Highway comprises over 6% of the total catchment area (Figure 6). Run-off from the catchment produces water with a high level of nutrient and sediment (Hydrosphere Consulting, 2015).

There are over 205 OSSM systems in the catchment and in 2011 BSC identified 37% of those were not operating properly or in accordance with BSC/RCC requirements. The village of Newrybar contains the greatest concentration of OSSM systems in the catchment.

Water is extracted from ECD and treated at the ECD WTP before supply to consumers through existing water distribution infrastructure.

3.3.2 Snapshot of Issues

The ECD catchment is the smallest of all RCC's drinking water catchments, however like the WRS, the majority of the catchment area is in private ownership, with unrestricted access. The key risks to water quality were identified as:

- Runoff from agriculture (e.g. sediment, nutrient and pathogens etc.).
- Direct stock access to waterways.
- Stream bank erosion and slumping.
- Poor riparian vegetation.
- On-site wastewater disposal (e.g. septic tanks).
- Contaminated land and dip sites.
- Roads – general road runoff (e.g. sediment, fuels, oils, brake fluids etc.)
- Hazmat spills – chemical spill enters watercourse/dam after truck/tanker road accident or industrial accident.
- Malicious contamination – dangerous chemicals are deliberately placed in source water.
- Natural soils/geology – elevated iron and manganese exceed ADWGs due to naturally occurring soil/geology.
- Algal growth and potentially toxic species of blue green algae are occasional issues in ECD.
- Carp are also observed throughout the system including ECD and are believed to cause benthic sediment disturbance which may facilitate greater nutrient release from sediment and increase turbidity.

These potential risks were assessed as part of the risk assessment process considering the current management undertaken as outlined below.

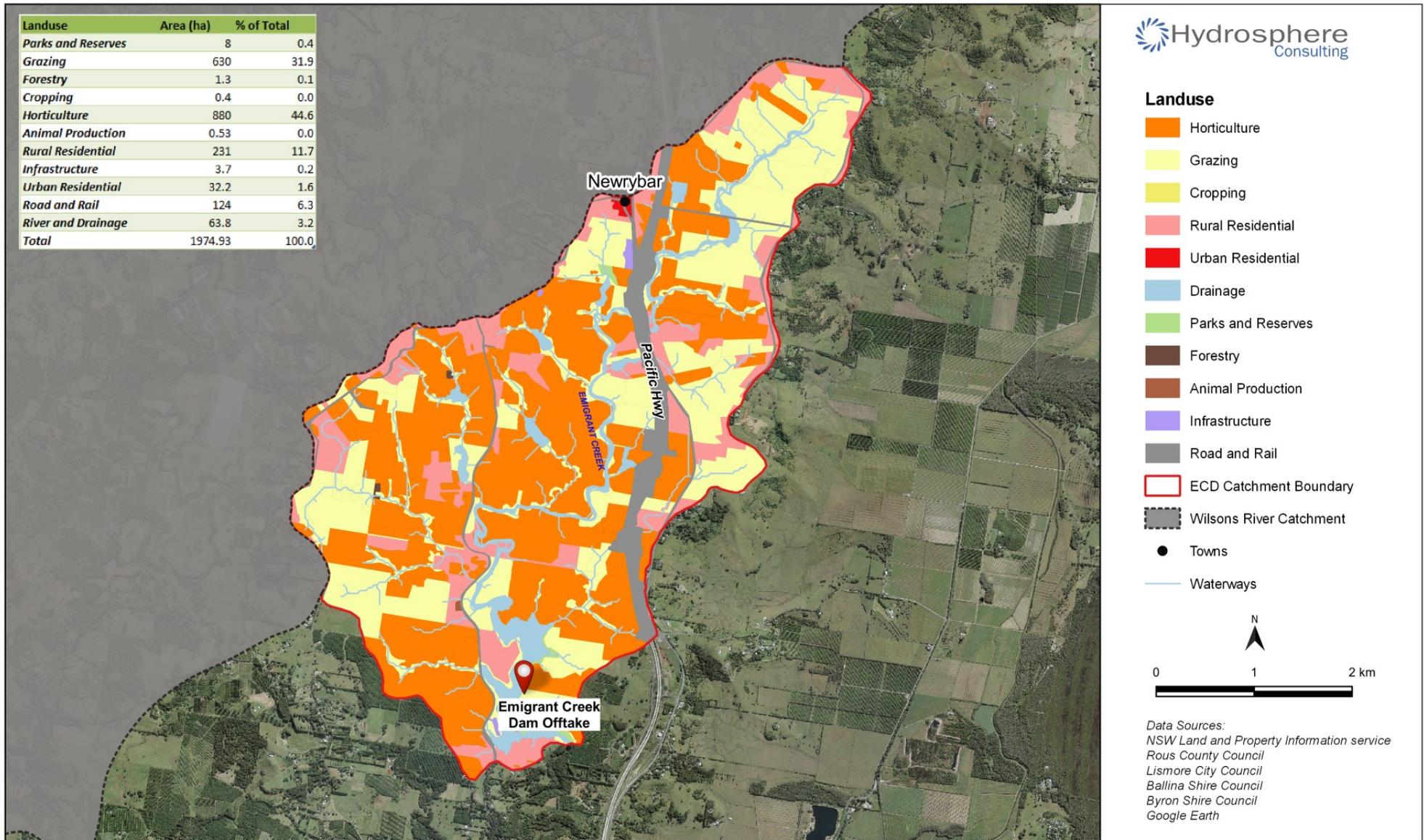


Figure 6: Emigrant Creek Dam catchment land use

3.3.3 Current Management

The review of management actions currently in place to control known water quality risks in the ECD catchment was undertaken as part of Stage 1 (Appendix 1). Catchment management measures for ECD include:

- Drinking water catchment signage at key locations to inform the public and provide call centre number to report spills etc.
- On-going RCC catchment surveillance activities.
- Hazmat spill response including capture, bund, and removal of contaminants by first responders (e.g. RFS, NSW Fire and Rescue). RCC notification of incident by EPA to allow adaptive management and verification testing as necessary.
- BSC planning controls and regulation of OSSM systems.
- River Reach Plans in the lower catchment upstream of ECD including establishment of vegetated buffer zones, and erosion control.
- RCC buffer zone establishment and maintenance around ECD.
- On-going fire detection and response.

In addition to these catchment controls there are turbidity limits on water extraction from ECD due to interference with treatment processes at ECD WTP.

ECD WTP treats water extracted from the dam before supply to customers in Lennox Head and Ballina. Section 3.4.3 provides further details of the WTP and processes.

3.3.4 Risk Assessment Outcomes

The risk assessment undertaken as part of Stage 2 updated catchment risk levels and assessed the effectiveness of management actions currently in place. Table 3 summarises the high priority risks identified through the catchment risk assessment process. Refer Appendix 1 for full results.

Table 3: High priority risks to drinking water in the ECD catchment

Hazard type	Hazard	Source	Hazardous event
Biological	Bacteria, Protozoa and Viruses	OSSM systems	Poor condition or poorly designed/constructed/ situated OSSM systems discharging harmful microbial pathogens to source water.
		Livestock access to waterways	Livestock faeces directly entering waterways discharging harmful microbial pathogens to source water.
	Problem Algae/aquatic weeds	OSSM systems	Poor condition or poorly designed/constructed/ situated OSSM systems discharging nutrient-rich effluent to source water
		Fertiliser	Fertiliser use that results in transport of excess nutrient to waterways through groundwater or surface water runoff (e.g. application rates too high or timing coincides with rainfall and runoff events etc.)
		Livestock	Nutrient-rich runoff from grazing land enters source water
		Livestock access to waterways	Livestock faeces directly entering waterways contribute nutrients directly to source water

Hazard type	Hazard	Source	Hazardous event
Chemical	Iron	Natural geology	Iron concentrations exceed ADWGs in source water and cause aesthetic problems in water. This is likely to be due to naturally occurring soil/geology.
	Hydrocarbons	Hazmat spills	Fuel spill enters watercourse after vehicle road accident.
	Pesticides	Agricultural pesticide use	Pesticides enter source water either directly (i.e. spray drift) or indirectly (i.e. in run-off)
	Pharmaceuticals and EDCs	OSSM systems	Poor condition or poorly designed/constructed/ situated OSSM systems discharging effluent containing endocrine disruptors (e.g. hormones both natural and synthetic, pesticides etc.) or pharmaceuticals enters source water
		Livestock access to waterways	Excretion of veterinary products enters source water
	Toxins (unknown contaminant)	Hazmat spills	Chemical spill enters watercourse after truck/tanker road accident or spill during delivery to WTP.
		Malicious contamination	Dangerous chemicals are deliberately placed in source water.
		Bushfire ¹	Major bushfire occurs in catchment and is followed closely by significant rainfall which transports pollutants (e.g. nutrients, organic matter, ash, metals and toxins) to raw water supply.
		Firefighting foams/retardants	Bushfire response leading to foams and chemical runoff. Also risk of nutrients from phosphate based fire retardants if used
	Physical	Taste and Odour	Suspended solids Algae
Turbidity		Road run-off	Runoff from unsealed roads enters source water carrying sediments and nutrients
		Bank erosion	Erosion of stream bed and bank mobilising sediments.
		Agricultural run-off	Runoff from areas of exposed soil enters watercourses carrying sediments.
		Livestock	Runoff from grazing land with elevated turbidity enters source water.
		Carp	Exotic fish causing benthic sediment disturbance which may facilitate greater nutrient release from sediment

1. While there are only small tracks of natural bushland classified as bush fire prone land within the ECD catchments, Macadamia orchards occupy approx. 45% of the catchment and are known to be highly flammable due to high oil content. For these reasons bushfire was considered a priority risk.

3.4 Potential Dunoon Dam Catchment

Dunoon Dam was first identified as a potential water source in 1995. The proposal involves the construction of a new dam on Rocky Creek, 14.6 river km downstream of the existing RCD and approximately 2.5km west of the village of Dunoon. Potential storage would be approximately 50,000ML at a full supply level of 85mAHD and have a surface area of approximately 220ha. Water from DD would be pumped to the Nightcap WTP and subsequently used for town water supply throughout the RCC service area. Currently, this option is being assessed among a range of other future water supply options, however, RCC has previously purchased land within the catchment as part of preliminary planning.

3.4.1 Catchment Description

The proposed DD has a catchment area of approximately 19km². Dunoon Dam would also receive overflows from RCD and therefore when RCD is spilling, the DD catchment area also incorporates the RCD catchment, giving a total catchment area of 50km². For the purposes of this CMP, the potential DD catchment is assumed to start downstream of RCD. Figure 7 provides an overview of mixed land use in the catchment. RCC currently owns several parcels of land within the DD catchment and would seek to purchase the remaining land within the buffer zone surrounding the dam, should this option be implemented for future water supply. The remaining catchment areas are either protected as parks and reserves or are under private ownership. Whian Whian Falls is a popular existing recreational location with easy access from the public road. If constructed, the upstream extent of DD would be just downstream of the base of the falls. Currently, cleared grazing land makes up approximately 40% of the catchment, horticulture (primarily macadamia farms) occupy 30%, and approximately 18% of the catchment is classified as Parks and Reserves (the majority of which is within Nightcap National Park). The remaining land uses comprise rural residential lots (4.6%), cropping (2.2%), forestry (1.3%) and rivers and drainage channels (4.4%).

3.4.2 Snapshot of Issues

The key risks to water quality were identified as:

- Recreational use – human waste enters watercourse from recreational activities (e.g. swimming) carrying harmful microbial pathogens.
- Wildlife – faecal matter from animals and birds contaminates water.
- Roads – general road runoff (e.g. sediment, fuels, oils, brake fluids etc.)
- Bushfire – major bushfire occurs in catchment and is followed closely by significant rainfall which transports pollutants (e.g. sediment, nutrients, organic matter, ash, metals and toxins) to raw water supply.
- Malicious contamination – dangerous chemicals are deliberately placed in source water.
- Natural soils/geology – elevated iron and manganese exceed ADWGs.
- Runoff from agriculture (e.g. sediment, nutrient and pathogens etc.).
- Direct stock access to waterways (e.g. nutrient and pathogens etc.).
- Stream bank erosion and slumping.
- Poor riparian vegetation.
- On-site wastewater disposal (e.g. septic tanks).
- Contaminated land and dip sites.

These potential risks were assessed as part of the risk assessment process considering the current management undertaken as outlined below.

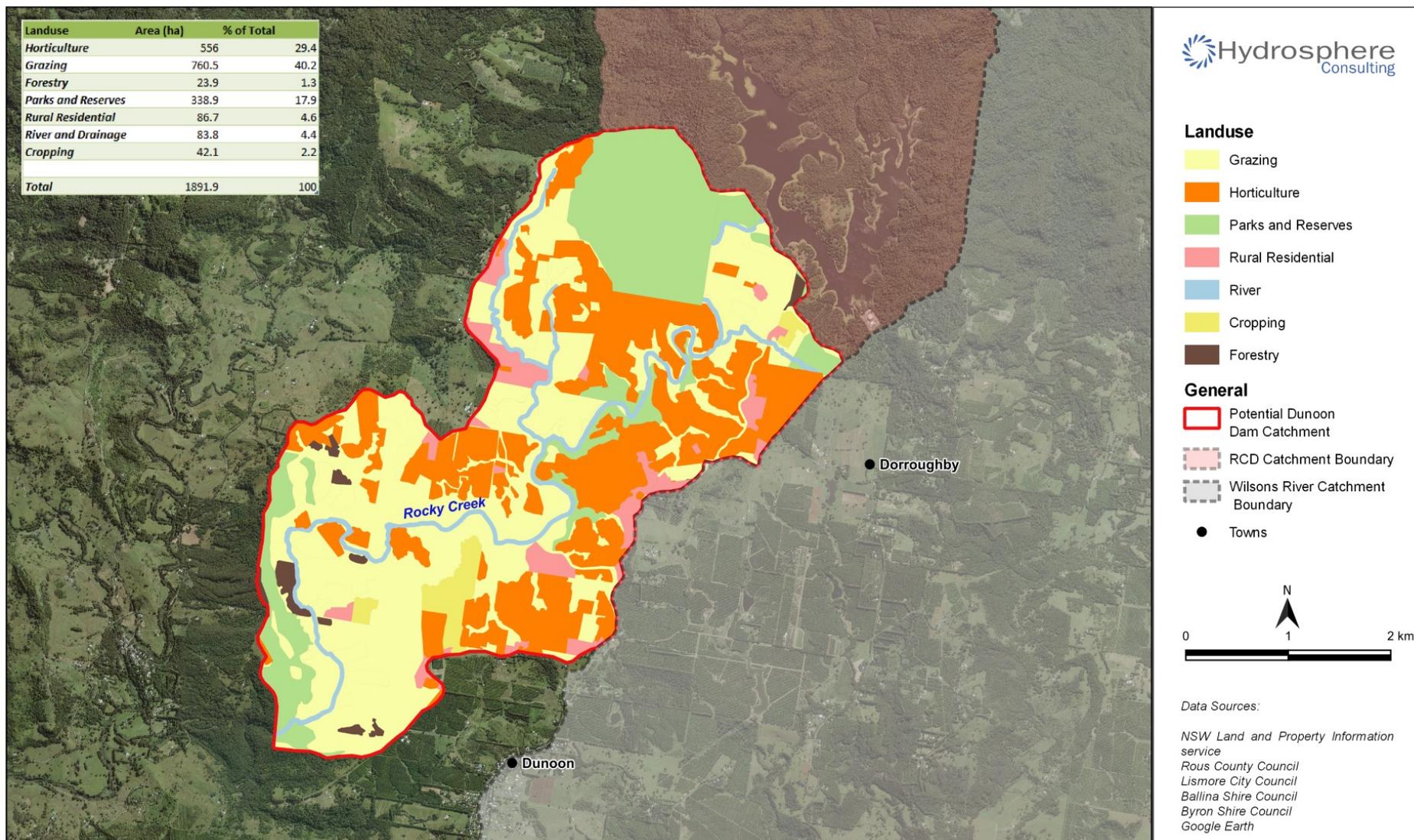


Figure 7: Potential Dunoon Dam catchment showing existing land use

3.4.3 Current Management

The review of management actions currently in place to control known water quality risks in the DD catchment was undertaken as part of Stage 1 (Appendix 1). RCC Catchment management measures are currently restricted to land management on RCC owned estate to maintain the land and typically comprise weed management activities and on-going RCC catchment surveillance activities.

3.4.4 Risk Assessment Outcomes

The risk assessment for the DD catchment was theoretical as it assumed the dam was already built with treatment at Nightcap WTP. This allowed for a comparative assessment of catchment risks to future water supply, if a new dam is constructed in this catchment. Table 4 summarises the high priority risks identified through the catchment risk assessment process. Refer Appendix 1 for full results.

Table 4: Potential Dunoon Dam drinking water risk assessment summary of results

Hazard type	Hazard	Source	Hazardous event
Biological	Bacteria, Protozoa and Viruses	Recreation	Human waste enters watercourse from recreational activities carrying pathogens
Chemical	Iron	Natural geology	Iron concentrations exceed ADWs in source water and cause aesthetic problems in water. This is likely to be due to naturally occurring soil/geology.
	Hydrocarbons	Hazmat spills	Fuel spill enters watercourse after vehicle road accident.
	Pharmaceuticals and EDCs	OSSM systems	Poor condition or poorly designed/constructed/ situated OSSM systems discharging effluent containing endocrine disruptors (e.g. hormones both natural and synthetic, pesticides etc.) or pharmaceuticals enters source water
		Livestock access to waterways	Excretion of veterinary products enters source water
	Toxins (unknown contaminant)	Hazmat spills	Chemical spill enters watercourse after truck/tanker road accident.
		Malicious contamination	Dangerous chemicals are deliberately placed in source water
		Bushfire	Major bushfire occurs in catchment and is followed closely by significant rainfall which transports pollutants (e.g. nutrients, organic matter, ash, metals and toxins) to raw water supply.
		Firefighting foams/retardants	Bushfire response leading to foams and chemical runoff. Also risk of nutrients from phosphate based fire retardants if used
Physical	Turbidity	Road run-off	Runoff from unsealed roads enters source water carrying sediments and nutrients
		Agricultural run-off	Runoff from areas of exposed soil enters watercourses carrying sediments.
		Livestock	Runoff from grazing land with elevated turbidity enters source water.

3.5 Water Treatment

Water from RCD and the WRS is treated at the Nightcap WTP. Water from ECD is treated at the Emigrant Creek Dam WTP. A description of WTP processes is provided below.

3.5.1 Nightcap Water Treatment Plant

Water from RCD and the WRS is treated at the Nightcap WTP. The plant is situated beside RCD, 200m above sea level in the Nightcap Range. Water from the Wilsons River does not enter Rocky Creek Dam but is piped separately into the plant.

Nightcap WTP was built in 1994 with major upgrades in 2000, 2006 and 2008. The plant utilises conventional processes together with advanced ozone and activated carbon treatment. It has a current capacity of 70ML/day with provision to upgrade to 100ML/day if required in the future. Table 5 and Figure 8 identify the series of processes used to remove pollutants from source water.

Table 5: Nightcap WTP treatment process

Process Step	Description	Purpose
Destratification	Aeration system within the dam	Prevent roll over and reduce conditions favoured by blue green algae and prevents the bottom of the dam becoming anaerobic.
Raw water	Pumped from RCD or WRS to the Nightcap WTP.	Raw water collection.
Chemical dosing	Hydrated lime and CO ₂ .	Buffer against changes in pH and prepare for coagulation.
Coagulation and flocculation	Alum and polyelectrolyte flash mixed prior to six two-stage flocculation tanks.	Formation of flocs.
Dissolved air floatation/filtration (DAFF)	Floc floats to surface to form a sludge, which is skimmed off and sent for further treatment. Deep sand filtration.	Removal of flocs and coagulant chemicals.
Ozone contact tank	Ozone generation on-site. Oxidation and breakdown of organic material. Ozone destruction.	Primary disinfection, destruction/inactivation of pathogenic organisms. Breakdown of taste and odour compounds, algal toxins, pesticide and herbicides.
Biologically activated carbon (BAC)	Filtration through adsorption and biological degradation.	Removal of nitrates, taste and odour compounds, algal toxins, pesticide and herbicides.
pH correction	Hydrated lime dosing.	Meet ADWG standards for drinking water.
Chlorination	Sodium hypochlorite dosing.	To ensure a chlorine residual to manage deterioration of water in the distribution network.
Wastewater processing	Sludge and backwash water thickening and clarified. Clarified supernatant is sent to the head of the plant. Dewatered sludge is trucked for disposal or reuse offsite.	Treatment and disposal of waste products.

Source: Adapted from Deere *et al.* (2015)

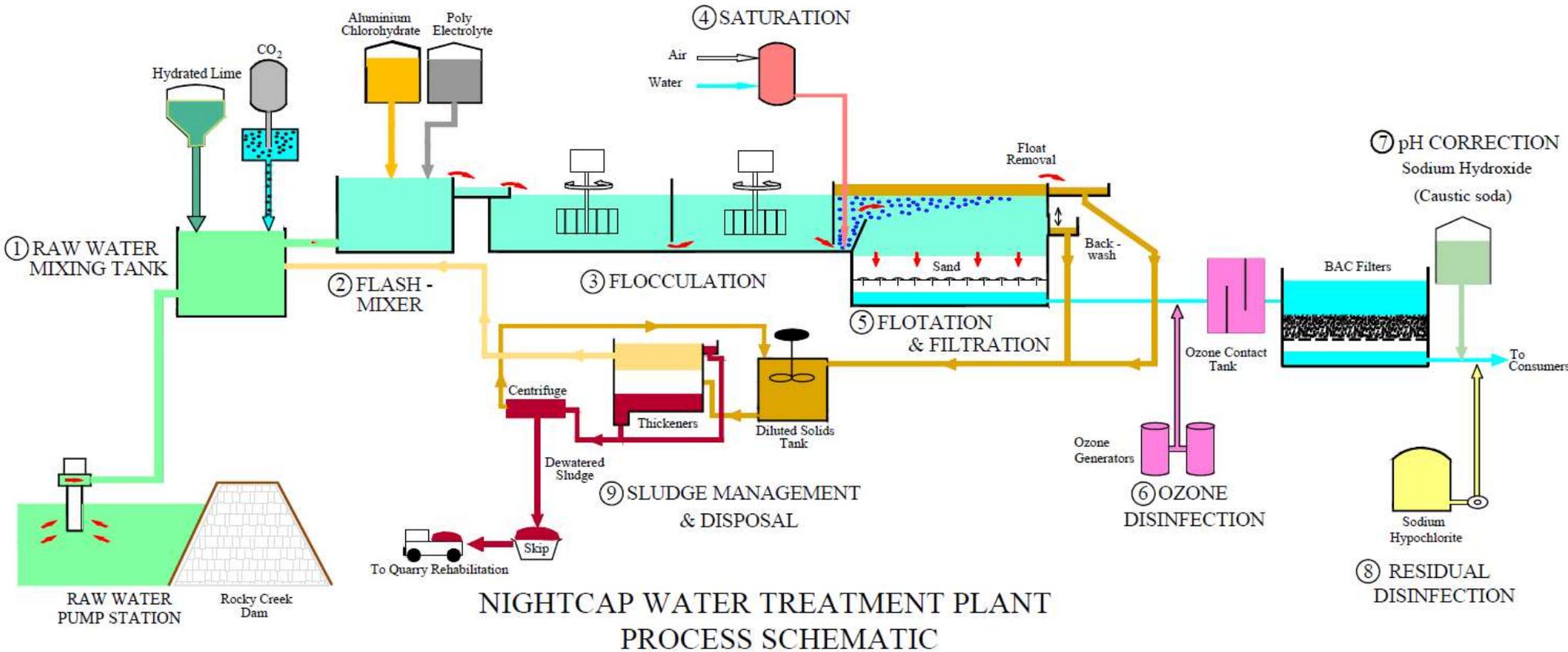


Figure 8: Schematic diagram of the Nightcap WTP process

Source: Hydrosphere Consulting (2017)

3.5.2 Emigrant Creek Water Treatment Plant

Water from ECD is treated at the Emigrant Creek WTP. The plant is situated beside ECD, approximately 70m above sea level at Knockrow, approximately 7km inland from Lennox Head.

Emigrant Creek WTP was built in 2005, replacing the Knockrow filtration plant. The plant utilises membrane filtration technology together with advanced ozone and activated carbon treatment. It can process up to 7.5ML/day and supplements water from Nightcap WTP to supply the Lennox Head and Ballina areas (RCC, 2019a). Table 6 and Figure 9 identify the series of processes used to remove pollutants from source water.

Table 6: Emigrant Creek WTP treatment process

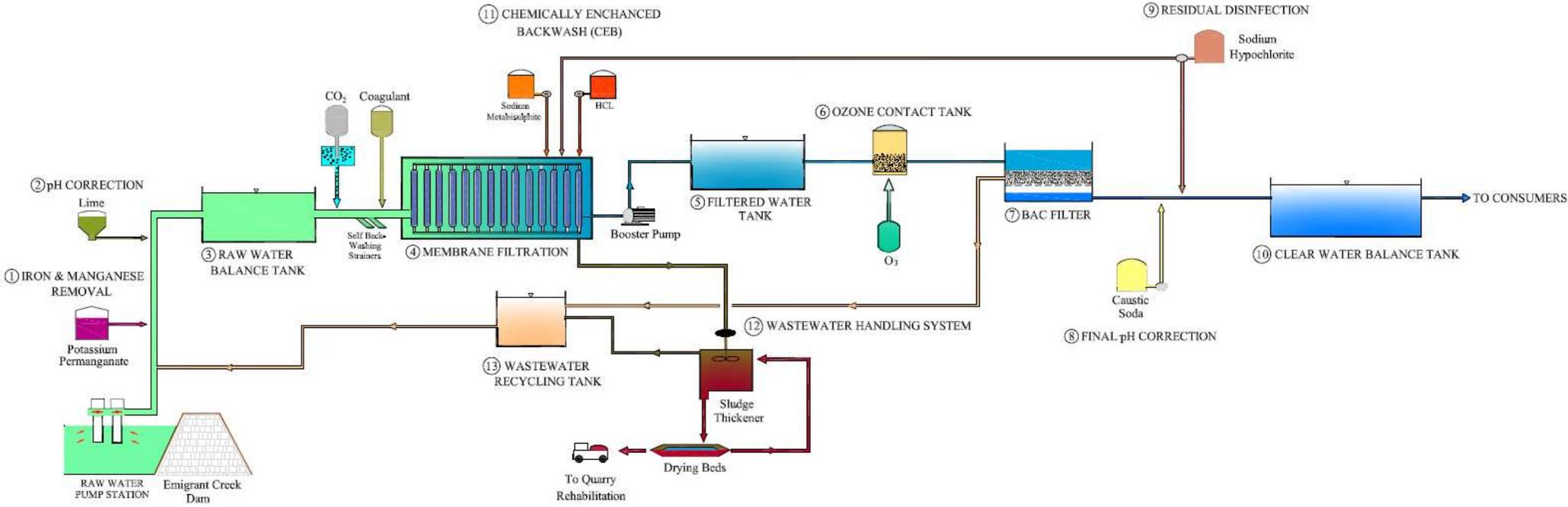
Process Step	Description	Purpose
Destratification	Aeration system within the dam	Prevent roll over and reduce conditions favoured by blue green algae and prevents the bottom of the dam becoming anaerobic.
Raw water	Pumped from ECD to the WTP	Raw water collection.
Chemical dosing	Potassium permanganate added. Lime is then added to the water to raise the alkalinity	Remove iron and manganese. Buffer against changes in pH and prepare for coagulation.
Raw Water Balance Tank	The 'dosed' raw water passes through the balance tank	Allow for reaction time and for the water to stabilise before further treatment.
Chemical dosing	CO ₂ and coagulant added	Formation of flocs.
Membrane Filtration Plant	Water passes through microscopic membrane filters	Removal of solids and microscopic organisms including bacteria, Cryptosporidium and Giardia, improve colour and eliminate odour.
Filtered Water Tank	The filtered water passes through the filtered water tank	Allow for the water to stabilise before further treatment.
Ozone contact tank	Ozone generation on-site. Oxidation and breakdown of organic material. Ozone destruction.	Primary disinfection, destruction/inactivation of pathogenic organisms. Breakdown of taste and odour compounds, algal toxins, pesticide and herbicides.
Biologically activated carbon (BAC)	Filtration through adsorption and biological degradation.	Removal of nitrates, taste and odour compounds, algal toxins, pesticide and herbicides.
Final pH correction	Caustic soda dosing	Meet ADWG standards for drinking water.
Chlorination	Sodium hypochlorite dosing.	Further correct the water properties and kill any bacteria or micro-organisms that may be in the water To ensure adequate chlorine residual to manage deterioration of water in the distribution network.

Process Step	Description	Purpose
Clearwater Balance Tank	Treated water passes through balance tank	Allow detention for disinfection to take place.
Knockrow Reservoir	Potable water is pumped to Knockrow reservoir	Storage and distribution to the community.
Wastewater processing	Sludge and backwash water thickening and clarified. Clarified supernatant is sent to the head of the plant. Dewatered sludge is trucked for disposal or reuse offsite.	Treatment and disposal of waste products.

Source: Adapted from Water Futures (2013)



Plate 1: Membrane filtration chambers at Emigrant Creek Dam WTP, October 2019.



Emigrant Creek Dam Water Treatment Plant Process Schematic

Figure 9: Schematic diagram of the ECD WTP process

Source: Hydrosphere Consulting (2017)

4. OVERVIEW OF CATCHMENT MANGEMENT APPROACH

The overall catchment management approach (Figure 10) outlines the key elements required to minimise water quality risks in the RCC drinking water catchments.

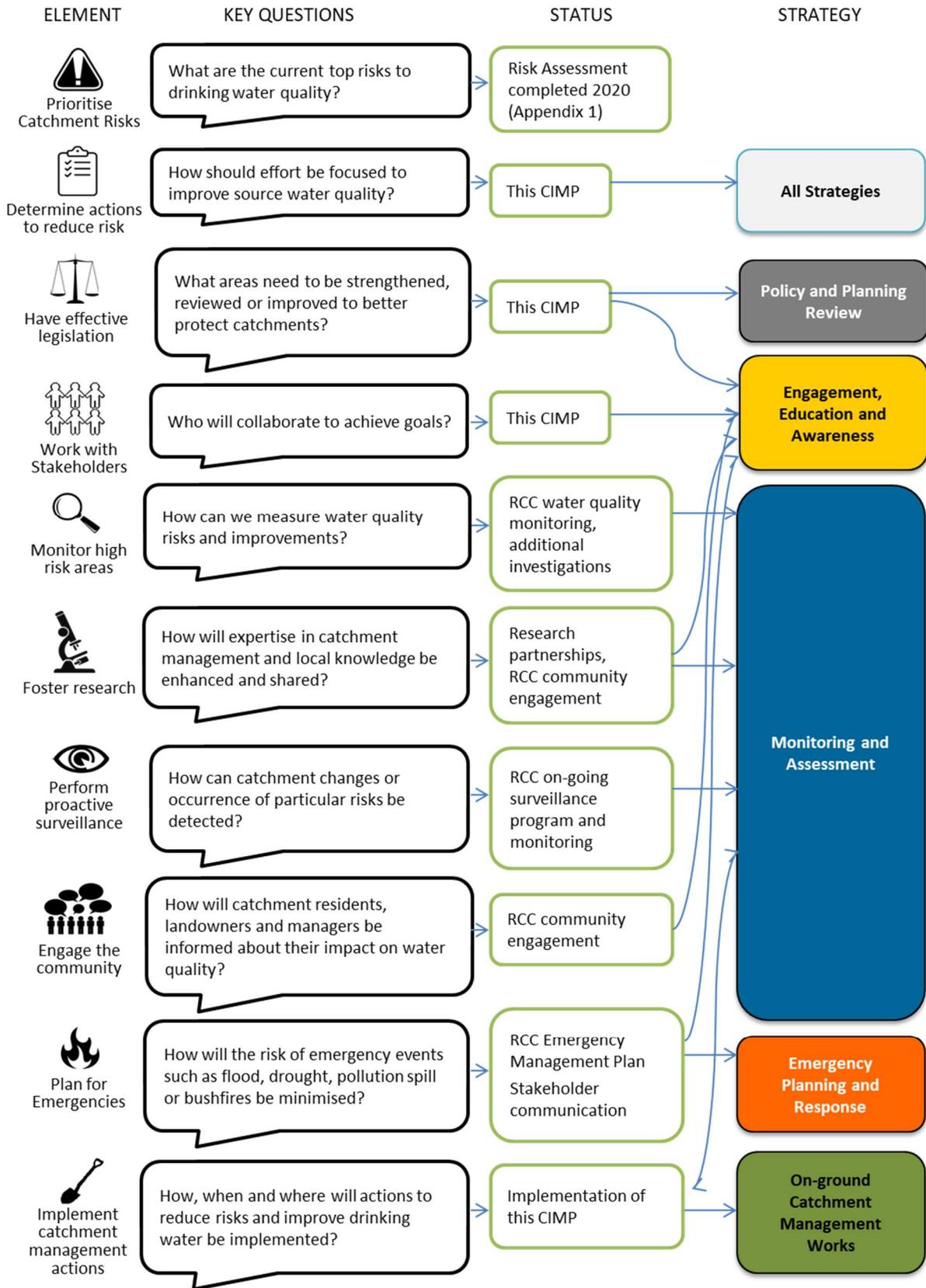


Figure 10: Elements of RCC catchment management

5. CATCHMENT STRATEGIES AND ACTIONS

Actions have been organised into five key strategies for implementation as shown in Table 7. All strategies have elements that are applicable to all catchments. Strategies 1-3 contain engagement, planning and emergency response actions generally applicable to all catchments. Strategy 4 Monitoring Evaluation and Reporting and Strategy 5 On-ground Catchment Management Works contain catchment specific actions for on-ground implementation at key locations.

Table 7: Key strategies for catchment management implementation

No.	Strategy	Description
1	Engagement, Education and Awareness	On-going promotion/education and awareness building of catchment risks, stakeholder responsibilities and ways to reduce risks to drinking water. Builds on existing RCC engagement activities and communicates current research and approaches.
2	Planning and Policy Review	Review and update of guidelines, policy and approval processes that impact on drinking water catchments (e.g. OSSM guidelines, development applications and DCPs etc.)
3	Emergency Planning and Response	Incorporates actions for review of emergency responses including procedures for Hazmat clean up and refining notifications, bushfire mitigation etc.
4	Monitoring Evaluation and Reporting	On-going water quality monitoring and catchment surveillance activities to assess risk, monitor changes and identify emerging issues. Investigation of specific risks to better understand the nature of the issue and determine actions required.
5	On-ground Catchment Management Works	Catchment remediation and rehabilitation works including River Reach Plan implementation and extension, farm-based erosion management plans and continuing buffer zone establishment and maintenance.

Actions have been developed from the outcomes of *Stage 1 Status of Existing RCC Catchment Management Plan (CMP) Actions* (Appendix 1) and *Stage 2 Drinking Water Catchments Risk Assessment 2020* (Appendix 2). Some actions, such as River Reach Plan extensions require an audit of completed work and condition assessment of new reaches prior to implementation of on-ground works. This is to ensure the appropriate effort, funding and geographical focus of on-ground works is undertaken.

Management strategies and actions have been developed for a five-year period. This CMP and the progress of the management actions should be reviewed annually and at the end of this period to ensure the actions remain relevant and the goals of the plan are being achieved.

The recommended management actions have been described in terms of:

- Desired outcome – the specific result to be achieved by implementation of each action.
- Priority ranking – each action has been assigned a rank and priority according to importance and urgency for implementation. The ranking is based on combined risk assessment outcomes. The priority categories have been assigned according to descriptions in Table 8.

Table 8: Priority Ranking

Priority	Description
Fundamental	Actions that are critical for successful implementation of the CMP and important for long-term effective catchment management
High	Actions of high importance in addressing key threats and issues
Medium	Actions considered of medium importance in addressing threats and issues
Low	Actions considered of low importance in addressing threats and issues relative to other issues

- Description of tasks – an outline of the scope of works required.
- Responsibility – RCC is the lead organisation for all actions and is responsible for implementation of the CMP. Support Organisation(s) may be required and/or requested to assist in implementation of the action, either through on-ground works, or as a potential funding or information source, but are not necessarily critical to success.
- Cost estimate – an estimate of total costs for implementation over the five year life of the plan is provided (2020\$). Section 8 provides a breakdown of action costs. Cost estimates cover the tasks listed in the actions (including preliminary investigations, environmental assessment, approvals and implementation) unless otherwise stated. Cost estimates provided in the action descriptions are preliminary only and are based on the best available information.
- Staff time estimate - the RCC staff resources associated with implementation of the identified strategies and actions have been estimated in terms of Equivalent Full Time (EFT) workload per year and is shown for every action.
- Potential funding – the CMP actions are expected to be funded through RCC catchment management budgets, monetary grants, staff time and contributions from catchment stakeholders (refer Section 6 for examples). Identification of grants and successful application is an important component of this CMP. A summary of funding sources is provided in Section 6.
- Timing – indicative timeframe for implementation and alignment with RCC's four year Delivery Program (DP) under the NSW Integrated Planning and Reporting (IP&R) Framework. Based on the priorities developed in this CMP, timeframes for management actions have been estimated, pending funding availability. The assumed start date for CMP implementation is 1 July 2020, following RCC adoption of the Plan. The CMP has a planning timeframe of five years therefore the duration of the Plan implementation period is from 1 July 2020 to 30 June 2025. Management actions have been scheduled according to the following timeframes:
 - Short term: year 1 – 2 (2021 – 2022).
 - Medium term: year 3 – 4 (2023 – 2024).
 - Long term: year 4 – 5 (2024 – 2025).
 - On-going: starting year 1 and implemented over the five year life of the CMP with possible extension beyond that period.
- Location – location of actions within catchments as applicable.
- Performance targets – performance targets for each action which can be used to measure the level of success.

6. FUNDING AND RESOURCES

The CMP actions are expected to be funded through RCC catchment management budgets, monetary grants and volunteer works by community members and organisations.

Some actions are funded under RCC's normal operating budgets throughout the five-year period, or through existing programs and grants. Where actions require RCC staff resources, actual costs have only been applied where it is expected that implementation will exceed current resourcing levels, in which case, additional funding is required. All actions will be supported by the day-to day project supervision of the RCC Natural Resource Management Planning Coordinator and the Natural Resource Officer. These staffing resources are funded through recurrent staffing costs that are already included in the Long Term Financial Plan so there is no additional staffing resources/costs associated with this aspect of the program.

RCC operates on an annual budget primarily funded through water rates and charges as well as fees and operating grants. It will not be possible for RCC to implement all actions identified in this CMP without additional sources of funding. As such, identification of grants and the submission of successful funding applications is an important component of this CMP. A list of current possible sources of external federal, state and local funding is provided below. However, it is important to note that many grants and funding sources change year to year, are only available up to a limited budget, or require significant co-funding commitment. It is also important to note that accurate estimates of project costs, particularly for on ground works cannot be accurately developed until audit and planning tasks have been completed, with these tasks often incurring significant costs. It will be necessary to keep abreast of current funding availability throughout the implementation of the CMP and take advantage of funding opportunities as they arise. In each case, the precise amount of funding available will not be known until it has been awarded.

Delivery of the actions will depend on the availability of funding which is yet to be confirmed. Despite the priority of each action listed in the CMP, the timeframe of implementation will be influenced by the availability of resources and funding.

Key sources of funding identified for the CMP actions are:

- RCC funds – generated through constituent council contributions and operating grants. It should be noted that RCC will typically not lodge funding applications for grants of less than \$20,000 due to the administration and project management loading associated with small grants.
- NSW Health Drinking Water Monitoring Program – NSW Health recommends that water suppliers monitor water quality in line with the ADWGs. NSW Health provides free of charge testing for water supply system monitoring for pesticides, indicator bacteria and health-related inorganic chemicals. All the data from the sampling undertaken within the Drinking Water Monitoring Program is stored in the Drinking Water Database. NSW Health laboratories provide free analysis for the allocated number of samples.
- The NSW Environmental Trust – administered by NSW Department of Planning Industry and Environment (DPIE) to fund a broad range of projects which enhance the environment of NSW. Relevant streams include environmental education, protecting our places (for the sharing and protection of Aboriginal Cultural knowledge and the protection, restoration and enhancement of culturally significant Aboriginal Land), research, restoration and rehabilitation projects and waste avoidance and resource recovery.
- Hort Innovation funding – Hort Innovation invests more than \$100 million each year into initiatives and programs that provide benefit to Australian horticulture growers, the wider horticulture sector and the community. Proposals can be submitted to Hort Innovation via an online submission form.

- DPE – Crown Lands:
 - Crown Reserves Improvement Fund Program for development and maintenance projects and to improve land and facilities on Crown land. Funding under this program is subject to a competitive grant application process and eligibility requirements which may change from year to year and in accordance with departmental priorities.
- Human resources and contributions may also be required from:
 - Constituent councils – LCC, BSC and BySC.
 - NPWS through maintenance and management of National Parks and Reserves in collaboration with RCC.
 - DPE – Crown Lands.
 - DPI – Fisheries.
 - RMS.
 - North Coast Local Land Services (LLS).
 - Landcare and other volunteer and community groups.
 - Educational and research institutions.

Where actions are being sufficiently implemented through an on-going concurrent program, additional expenditure and funding have not been included.

7. CATCHMENT MANAGEMENT PLAN ACTIONS

A targeted management plan has been prepared to document prioritised management actions based on catchment risk. Proposed actions are those deemed to be affordable, have tangible benefit and contribute to the long-term vision for management of the RCC drinking water catchments. Prior to inclusion of an action, it was critically evaluated to ensure that it can be effectively implemented, taking into consideration the limitations imposed by responsibilities, funding, environmental conditions and community support.

The extent to which catchment pollution can be controlled or remediated is often limited in practical terms where land is not under the direct control of RCC. On-ground works on RCC owned land in the vicinity of the raw water off-takes and dam buffer zones are the highest priority and this work is on-going as part of RCC operational budgets. This CMP proposes additional actions to be implemented on private land through the extension of River Reach Plans to better protect catchments and focus on identified risks to drinking water quality.

Effective catchment management also requires effective collaboration between a range of stakeholders including RCC, local governments, state government agencies and regulators, the agricultural sector, landowners and the community. All catchment stakeholders have a role to play from regulation, development control, land management and wastewater management to riparian improvement. During Stage 1, it was identified that a number of actions in previous catchment management plans were incomplete or their status was unknown due to those actions being outside of the direct control of RCC. This CMP focuses on those actions under the direct control of RCC, while continuing to work with catchment stakeholders and collaborating wherever potential overlaps exist. To facilitate collaborative efforts this CMP sets a clear division of responsibilities between RCC and other stakeholders. This is defined for each action by providing a list of 'Support Organisation(s)' as applicable. RCC is the lead organisation for all actions in this CMP. Several actions in the CMP require specific consultation and collaboration with a range of stakeholders in addition to the on-going communication between RCC and stakeholders as part of everyday operations.



Plate 2: Emigrant Creek Dam

Source: RCC (2017)

7.1 Actions Applicable to all Catchments

7.1.1 Strategy 1: Engagement, Education and Awareness

RCC implements a range of community awareness projects across all catchments aimed at enhancing community understanding of the value of water. Community awareness programs should be continued and built upon to increase community awareness of issues and responsibilities of all stakeholders in the protection of drinking water quality. Diffuse sources of pollution arising from agricultural activities and stormwater pollution are difficult to manage but their effect on water quality can be minimised by increasing awareness of impacts and the use of best practice management. Landowners and residents can be encouraged to protect water quality through community awareness programs. The following actions have been identified as specific areas of focus for the future engagement, education and awareness program.



Plate 3: Examples of RCC engagement materials and activities

Source: www.rous.nsw.gov.au

Action A1: Catchment Landholder Education and Awareness

Desired Outcome	On-going promotion/ education and awareness building concerning the impact of catchment activities on drinking water quality and the role of all catchment stakeholders in protecting catchments
Priority ranking	High
DESCRIPTION OF TASKS:	
<ol style="list-style-type: none"> 1. Educational materials: Continue to promote and distribute existing educational materials (e.g. <i>Landholders guide to looking after waterways in the Richmond Catchment</i> (booklet) (RCC, 2017); <i>My Local Native Garden Guide</i> (RCC and LCC, 2016); <i>NSW Weed Control Handbook</i> (DPI, 2018); and industry Best Practice Management Guidelines. 2. Targeted extension and awareness programs: Continue engagement activities and community events including: Primary and secondary school education programs; RCC Catchment Trailer display; Big Scrub Rainforest Day; Primex display; World Environment Day Tree Planting; Clean Up Australia Day etc. 3. Spills and contamination: On-going promotion/education and awareness building concerning water quality risks associated with spills and incidents. This includes: <ol style="list-style-type: none"> a. Maintain current actions including: drinking water catchment signage with contact number to report all spills; and stormwater stencilling etc. b. Engagement and awareness activities including promotion of ChemClear and DrumMuster Programs which provide a safe disposal path for unwanted agricultural chemicals. 4. Water quality information: Communicate results of water quality investigations (refer Action A5: RCC Catchment Water Quality Monitoring Program) through publication on RCC website, email notifications and media release. 5. Liaise with LCC regarding progress to implementation of Lismore Urban Stormwater Management Plan 2016. 6. Catchment landholder welcome pack: Provide a 'welcome pack' to new residents in RCC drinking water catchments providing background information and advising of their new responsibilities. This initiative would target landholders at the outset of their ownership of a property within a drinking water catchment. Tasks include: <ol style="list-style-type: none"> a. Confirm welcome pack contents including welcome letter, educational materials and contact details for further information. Existing educational materials such as those discussed in no. 1 above are considered suitable and should be tailored to the location of the property in the catchment (e.g. rural packs to include information on OSSM system operation and agricultural best practice; urban packs to contain information about stormwater pollution and chemical/pesticide use in gardens etc.). b. Work with local councils to identify a method to trigger welcome pack distribution (e.g. property registration, rates notice name change etc.). c. Distribute welcome pack at change of ownership. 	
Lead Organisation	RCC
Support Organisation(s)	Local councils – LCC, BSC, BySC Government agencies: NSW Health, EPA, LLS, DPI, RMS, NPWS Industry bodies: AMS, NCMC, NSW Farmers Hazmat Response agencies: RFS, NSW Fire and Rescue Community groups and representatives including Landcare groups as relevant.
Total Cost Estimate (5 year)	\$175,000 (allowance of \$35,000/yr for engagement activities, community events, printing and distribution of welcome pack, etc.)
Total RCC Staff Time Estimate (5 year)	0.75 EFT (estimate of 0.15 EFT/yr for 5 years)
Potential Funding Sources	RCC, NSW Environmental Trust, Local councils – LCC, BSC, BySC
Timing	On-going (2020-2025)
Performance Targets	<ul style="list-style-type: none"> • Welcome pack complete and ready for distribution by Jan 2021

7.1.2 Strategy 2: Planning and Policy Review

Well-designed planning regulations are a critical component of sound catchment management and protection of water quality (NHMRC, NRMCC, 2011). Planning regulations should address management and control of high-risk land use in catchments and should also address the issue of long-term incremental development. Urban development, agriculture and general industry should be carefully scrutinised to ensure that they will not impact on water resources. On-site waste treatment and disposal systems should be permitted only where sites are suitable and there is minimal risk to the water supply. Such systems should be designed, installed and maintained correctly, and inspected regularly. Defects should be reported and rectified.

Where possible, protection of water resources should be included as a principal objective in planning policies. Responsibility for the development and implementation of planning strategies and regulations is generally shared between state and local government agencies. It is important that drinking water suppliers and environment and health authorities establish strong links with planning agencies and take an active role in the development or amendment of these planning strategies and regulations; and the evaluation of individual development proposals with respect to potential impacts on water quality or quantity.

Where appropriate, formal agreements should be required to ensure approval conditions are complied with and recorded on land titles to alert potential purchasers of the obligations associated with the property.

Action A2: OSSM System Planning and Policy Review

Desired Outcome	Effective regulation of OSSMS in drinking water catchments to minimise water quality impacts
Priority ranking	Medium
DESCRIPTION OF TASKS:	
<ol style="list-style-type: none"> 1. Review and update the <i>Rous Water On-Site Wastewater Management Guidelines</i> (RCC, 2008) to provide guidance for managing OSSM systems located within a RCC drinking water catchment in line with current best practice and local council regulatory frameworks. 2. RCC to request councils to include considerations for OSSM systems in all DCPs as applicable to catchment areas. 	
Lead Organisation	RCC
Support Organisation(s)	Local councils – LCC, BSC, BySC Government agencies: NSW Health, EPA
Total Cost Estimate (5 year)	\$50,000 (allowance of \$50,000 for external planning review)
Total RCC Staff Time Estimate (5 year)	0.2 EFT (estimate of 0.2 EFT in year 3)
Potential Funding Sources	RCC
Timing	Medium term (year 3 2022/23)
Performance Targets	<ul style="list-style-type: none"> • Review complete by June 2023

Action A3: Development Planning and Policy Review

Desired Outcome	<p>Effective regulation of development in drinking water catchments to minimise water quality impacts.</p> <p>Local Councils systematically apply RCC requirements when assessing development applications occurring in drinking water catchments.</p>
Priority ranking	Medium
DESCRIPTION OF TASKS:	
<ol style="list-style-type: none"> 1. Review and update the <i>Development Control Plan for Development within the Rous Water Catchments</i> (RCC, 2009) in line with current best practice and local council regulatory frameworks. 2. Review of the overall development application/review process in partnership with local council including: <ol style="list-style-type: none"> a. Establish one set of requirements from RCC applicable to developments within RCC drinking water catchments. b. Determine requirements for referral of development applications to RCC when required. 3. Consult with LCC regarding implementation progress of the <i>Lismore Urban Stormwater Management Plan</i> (Hydrosphere Consulting, 2016) with regard to objectives for drinking water catchments. 	
Lead Organisation	RCC
Support Organisation(s)	<p>Local councils – LCC, BSC, BySC</p> <p>Government agencies: NSW Health, EPA</p>
Total Cost Estimate (5 year)	\$60,000 (allowance of \$60,000 for external planning review)
Total RCC Staff Time Estimate (5 year)	0.2 EFT (estimate of 0.2 EFT in year 3)
Potential Funding Sources	RCC
Timing	Medium term (year 3 2022/23)
Performance Targets	<ul style="list-style-type: none"> • Reviews complete by June 2023

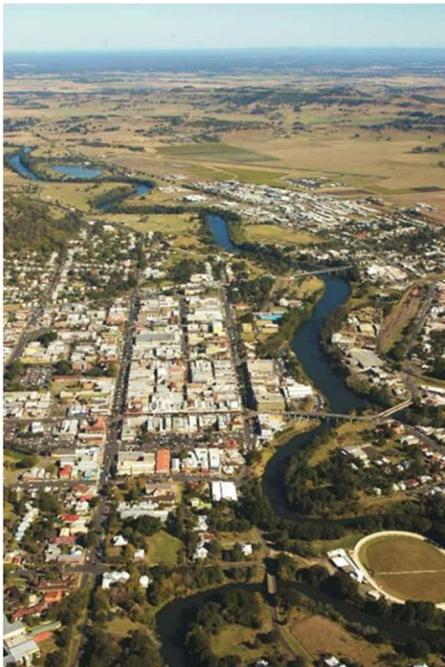


Plate 4: Left: Wilsons River Source tidal pool at Lismore, Top right: Browns Creek stormwater channel, Bottom right: Browns Creek channel during heavy rainfall

Source: Ecos (2009b); Hydrosphere Consulting (2016)

7.1.3 Strategy 3: Emergency Planning and Response

Action A4: Spills and Contamination Emergency Response and Notification Protocol

Desired Outcome	<p>Continue to raise awareness of Hazmat response agencies about drinking water catchment locations and the heightened risk of contamination incidents occurring within catchments.</p> <p>Fast and effective clean-up of spills and contamination events to minimise drinking water risks.</p> <p>Timely notification to RCC to allow for adaptive management as part of operations to minimise risk to public health.</p>
Priority ranking	High
DESCRIPTION OF TASKS:	
<p>1. Formalise and gain agreement between responsible agencies on Hazmat response and clean up in drinking water catchment areas including:</p> <ol style="list-style-type: none"> Hazmat incident notifications procedure between first responders, the EPA and RCC. Suitable time frames for notifications to be agreed to allow for timely management. Confirm training and education of first responder staff is adequate to determine whether an incident is located in a drinking water catchment and the necessary additional steps required to minimise drinking water risk. 	
Lead Organisation	RCC
Support Organisation(s)	<p>Hazmat response agencies: RFS, NSW Fire and Rescue</p> <p>Government agencies: EPA, NSW Health, NPWS, RMS</p> <p>Local councils – LCC, BSC, BySC</p>
Total Cost Estimate (5 year)	n/a
Total RCC Staff Time Estimate (5 year)	0.025 EFT (estimate of 0.025 EFT in year 1)
Potential Funding Sources	n/a
Timing	Short term (year 1 2020/21)
Performance Targets	<ul style="list-style-type: none"> Protocol agreed by June 2021

7.1.4 Strategy 4: Monitoring Evaluation and Reporting

There are a number of on-going monitoring and assessment actions across RCC catchments that are important to continue as part of the overall catchment management approach.

The RCC Catchment Water Quality Monitoring Program is an on-going part of the RCC DWMS to assess raw water quality risk and inform operational management of drinking water. Water quality data allows for detailed assessment of risk and should be on-going. Additional investigative monitoring and assessment actions have been identified within each catchment to measure the success of previous work, evaluate emerging risks and to provide information for evidence-based recommendations for on-going work. The on-going RCC Catchment Surveillance Inspections Program is an essential component of the RCC DWMS to identify any changes in catchments, or activity or conditions that present a risk to drinking water quality.

Action A5: RCC Catchment Water Quality Monitoring Program

Desired Outcome	Continue catchment water quality monitoring to assess risk, monitor changes, allow for operational adaptive management as needed and identify emerging issues
Priority ranking	Fundamental
DESCRIPTION OF TASKS:	
<ol style="list-style-type: none"> 1. Continue the RCC Catchment Water Quality Monitoring Program in all drinking water catchments. The following modifications are recommended based on review of data: <ol style="list-style-type: none"> a. Modify 6-monthly pesticide screening at offtakes (currently the standard OC/OP screen) to include chemical compounds previously detected as part of intensive pesticide monitoring programs (i.e. Glyphosate, Triclopyr and Dicamba detected in 2003/04 intensive sampling program). 2. Conduct an annual review of catchment water quality data and document results in an annual report card. This will allow for timely assessment and review of trends and any areas of concern. 3. Conduct a comprehensive review of catchment water quality data every five years to examine trends in detail and review and update the monitoring program methodologies and outputs. 4. Communicate results of catchment water quality monitoring to the catchment working groups annually. 5. Publish annual report card on RCC webpage to inform the community of catchment water quality status and raise awareness of issues and areas for improvement. 	
Lead Organisation	RCC
Support Organisation	NSW Health
Total Cost Estimate (5 year)	\$50,000 in additional costs to the on-going program which is funded under RCC operational budget (allowance of \$3,000 per year for additional pesticide monitoring at offtake sites, \$5,000 for set up of annual report card, and \$30,000 for comprehensive water quality review in year 2)
Total RCC Staff Time Estimate (5 year)	0.25 EFT (estimate of 0.05 EFT/yr for 5 years)
Potential Funding Sources	RCC, NSW Health
Timing	On-going (2020-2025)
Location	Water quality monitoring sites
Performance Targets	<ul style="list-style-type: none"> • Annual water quality report card published on RCC website by June 2021 • Comprehensive review report of catchment water quality data complete by June 2022

Action A6: RCC Catchment Surveillance Program

Desired Outcome	Regular inspections of the catchment areas in order to identify any activity or conditions that present a risk to catchment integrity and water quality.
Priority ranking	Fundamental
DESCRIPTION OF TASKS:	
<ol style="list-style-type: none"> 1. Continue the RCC Catchment Surveillance Program in all drinking water catchments. 2. Review and update <i>RCC Catchment Surveillance Inspections Program</i> (RCC, 2011) including: <ol style="list-style-type: none"> a. Document incidents recorded since previous review including remedial actions and need for changes to program etc. b. Update responsibilities, agency names and duties in accordance with current information. 	
Lead Organisation	RCC
Support Organisation	Local councils – LCC, BSC, BySC Government agencies: NPWS, NSW Health
Total Cost Estimate (5 year)	n/a
Total RCC Staff Time Estimate (5 year)	0.25 EFT (estimate of 0.05 EFT/yr for years 1-5)
Potential Funding Sources	RCC
Timing	On-going (2020-2025)
Location	All catchment areas
Performance Targets	<ul style="list-style-type: none"> • Review and update of 2011 <i>RCC Catchment Surveillance Inspections Program</i> by June 2021

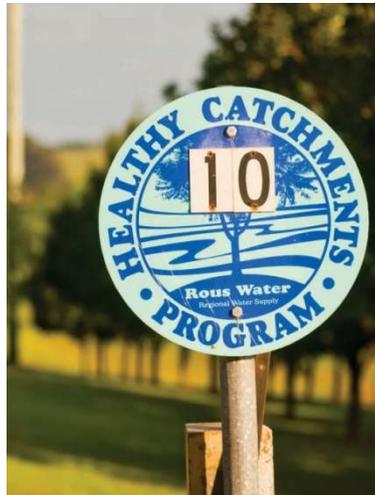


Plate 5: Catchment imagery

Source: RCC (undated)

Action A7: Intensive Pesticide Sampling Program

Desired Outcome	Provide information to better assess the risk of pesticide use in catchments to public health.
Priority ranking	Medium
DESCRIPTION OF TASKS:	
<p>1. Conduct intensive pesticide monitoring program in each catchment to better define risk and provide up to date information. The last intensive program was completed in 2009-2010 (over 10 years ago) and therefore an updated program is necessary to evaluate current risks considering changes in pesticide use and current monitoring techniques and technology. Refer to RCC Pesticide Risk Assessment 2020 for recommendations for monitoring including the use of emerging technology (passive samplers) to better assess risk.</p> <p>2. Based on the results of the investigation provide recommendations for management as required.</p>	
Lead Organisation	RCC
Support Organisation	NSW Health, research organisations
Total Cost Estimate (5 year)	\$75,000 (allowance of \$65,000 for passive sampling program assuming seasonal sampling – summer, autumn, winter, spring at RCD, ECD and WRS offtake sites and \$10,000 for final report)
Total RCC Staff Time Estimate (5 year)	0.1 EFT (estimate of 0.1 EFT in year 2)
Potential Funding Sources	RCC, NSW Health
Timing	Short term (year 2 2021/22)
Location	RCD, ECD ,WRS offtakes
Performance Targets	<ul style="list-style-type: none"> Intensive program final report completed by Oct 2023



Plate 6: RCC Healthy Catchments postcard

Source: RCC (undated)

Action A8: Investigate Potentially Harmful Contaminants

Desired Outcome	Provide information to better assess the risk of catchment pollutants (e.g. pharmaceuticals, endocrine disrupting compounds (EDCs) and PFAS).
Priority ranking	Medium
DESCRIPTION OF TASKS:	
<p>1. Investigation to determine the presence and potential impacts of pharmaceuticals, EDCs and PFAS (Per- and poly-fluoroalkyl substances used in firefighting foams) in source water. The risk assessment for the WRS identified that there are known potential sources of these contaminants in the catchment (e.g. OSSM systems, municipal wastewater discharge and excretion of veterinary products by stock and fire fighting activities) however, to date there has not been any assessment of presence and levels in source water. This combined with an unknown treatment capacity at Nightcap WTP resulting in a medium residual risk being assigned to this hazard (refer Section 3.1). In order to better define the risk level, an investigative study is recommended to provide more information on potential human exposure from drinking water. This task involves:</p> <ol style="list-style-type: none"> Design of sampling program. This initial investigation may be incorporated into the intensive pesticide monitoring program using passive samplers which can detect micro pollutants in source water including pharmaceuticals, EDCs and PFAS. Conduct sampling. The raw water offtakes in RCD, ECD and WRS are proposed as suitable locations for sampling source water in the first instance. Depending on results of this initial investigation, further sites may be proposed to better assess sources of contamination etc. Analyse results assess risk to human health. The Australian National Guidelines for Water Recycling (Phase 2) provide guideline concentrations for EDCs (and an approach for further developing guidelines) that are applicable to potable water supplies (NRMMC, EPHC and NHMRC 2008). <p>2. Based on the results of the investigation provide recommendations for management as required.</p>	
Lead Organisation	RCC
Support Organisation	NSW Health
Total Cost Estimate (5 year)	\$12,000 (allowance of additional \$12,000 for passive sample program assuming completed in conjunction with pesticide sampling)
Total RCC Staff Time Estimate (5 year)	0.1 EFT (estimate of 0.1 EFT in year 2)
Potential Funding Sources	RCC, NSW Health
Timing	Medium term (year 2 2021/22)
Location	Source water offtakes (RCD, ECD, WRS)
Performance Targets	<ul style="list-style-type: none"> Final report completed by Oct 2023

Action A9: Performance Monitoring and Review of Actions

Desired Outcome	Review of CMP progress and monitoring of performance targets to ensure continuous improvement and that actions and approaches remain appropriate.
Priority ranking	Fundamental
DESCRIPTION OF TASKS:	
<ol style="list-style-type: none"> 1. Annual reporting: Documentation of the effectiveness of the proposed actions will be reported as part of RCC's IP&R framework including progress towards the performance targets included in each action. 2. Five year review of the CMP will provide a basis for future catchment management planning. The review is required to consider: <ol style="list-style-type: none"> a. Results of IP&R Reporting. b. Status of CMP actions including overall success and any barriers to effective implementation. c. Data provided by water quality investigations. d. Any new or updated scientific knowledge, technology or catchment changes. e. Prevailing community attitudes, government policy and strategic planning status. 	
Lead Organisation	RCC
Support Organisation	n/a
Total Cost Estimate (5 year)	n/a
Total RCC Staff Time Estimate (5 year)	Staff time allocated under existing budgets
Potential Funding Sources	RCC
Timing	On-going (2020-2025)
Location	All catchment areas
Performance Targets	<ul style="list-style-type: none"> • Annual IP&R reporting (years 1-5) • Five year review report completed by June 2025



Plate 7: Left: Rainforest regeneration 1 year after Lantana removal at Rocky Creek Dam; Right: Recovery after 30 years

Source: McDonald (2016)

7.2 Rocky Creek Dam Catchment Actions

There are a number of management actions currently in place to control known water quality risks in the RCD catchment. Action RC10: RCD On-going Catchment Controls RC10 lists the current controls that remain in force. Actions RC11-13 detail the additional tasks identified for implementation in the catchment over the next five years.

Action RC10: RCD On-going Catchment Controls

Desired Outcome	Continue current catchment controls to manage risks to drinking water quality.
Priority ranking	Fundamental
DESCRIPTION OF TASKS:	
<ol style="list-style-type: none"> Maintain drinking water catchment signage. The signage includes: (a) general prohibition signage; (b) restricted area advisory signage; (c) educational signage regarding the sensitivity of the local environment; and (d) no swimming prohibition signage. Continue catchment surveillance and informational and regulatory signage to minimise recreational use of waterways in the RCD catchment. Refer Action A6: RCC Catchment Surveillance Program. Liaise with NPWS to maintain current controls and consider drinking water risks in decision-making (i.e. bushfire detection and response, land stabilisation works, recreational trail maintenance, management trails maintenance, catchment surveillance). Also refer Action RC13: On-going Collaboration with NPWS. Hazmat spill response (refer Action A4: Spills and Contamination Emergency Response and Notification Protocol). On-going fire detection and response. Chemical certification required for all RCC/NPWS staff and contractors undertaking chemical application in the catchment (e.g. for weed control etc.). Reservoir management undertaken by RCC is in accordance with DWMS (i.e. aeration/destratification, algal alerts, depths of abstraction, customer complaints process, removal or algae from wastewater etc.) Continue to implement formal procedure for the receipt of chemicals at Nightcap WTP that includes risk management controls for every stage of the chemical delivery process, thereby minimising the risk of spills to stormwater. Upgrade of chemical storage and delivery facilities to prevent drainage of internal process areas to stormwater (currently underway in 2020). Monitor performance of new facilities. Regular inspections and servicing/maintenance of Nightcap WTP OSSM system to ensure optimal performance. Adherence to relevant legislation and related regulations and guidelines controlling pollution of the environment and development planning (i.e. <i>Protection of Environment Operations Act 1997; Environmental Planning and Assessment Act 1979; Local Government Act 1993; Contaminated Land Management Act 1997; Pesticides Act 1999; Biodiversity Conservation Act 2016; Soil Conservation Act 1938, National Parks and Wildlife Act 1974</i>). 	
Lead Organisation	RCC
Support Organisation	NPWS
Total Cost Estimate (5 year)	No additional costs
Total RCC Staff Time Estimate (5 year)	0.25 EFT (estimate of 0.05 EFT/yr for 5 years)
Potential Funding Sources	RCC, NPWS
Timing	On-going (2020-2025)
Location	RCD catchment
Performance Targets	<ul style="list-style-type: none"> Refer Action A9: Performance Monitoring and Review of Actions

7.2.1 Strategy 4: Monitoring Evaluation and Reporting

Action RC11: Post-Bushfire Review of Water Quality and Catchment Condition

Desired Outcome	Consider results of post-bushfire catchment and water quality condition assessment to understand impacts of bushfire on water quality and recommend adaptive management as required.
Priority ranking	Medium
DESCRIPTION OF TASKS:	
<p>RCC and NSW Health are currently undertaking a post-bushfire review of water quality and catchment condition in NSW following the unprecedented 2019 bushfire season. RCC catchment is included in this assessment. The following tasks are outlined:</p> <ol style="list-style-type: none"> 1. Review NSW Health reporting when available including water quality conclusions (i.e. contaminants, turbidity, Chromium 6 etc.), key risk factors and implications for drinking water catchment management, treatment and supply. 2. Based on the information compiled as part of no.1, build an understanding of the potential consequences of bushfire impacts on source water quality and implications for water treatment processes at Nightcap WTP. 3. Collaborate with NPWS in the review of the <i>Nightcap National Park, Whian Whian State Conservation Area and Snows Gully Nature Reserve Fire Management Strategy</i> (NPWS, 2005) incorporating considerations from the post-bushfire review. Based on preliminary review the following updates are required to the fire management strategy: <ol style="list-style-type: none"> a. Acknowledge and include RCC infrastructure (i.e. RCC and WTP) as a critical public asset in the catchment with potential to be negatively impacted by bushfire. b. Include RCC as a contact in the plan. 	
Lead Organisation	RCC
Support Organisation	Government agencies: NPWS, NSW Health RFS, NSW Fire and Rescue
Total Cost Estimate (5 year)	\$10,000 (allowance of \$5,000 for Year 1 and 2 to cover any additional water quality testing that may be required)
Total RCC Staff Time Estimate (5 year)	n/a
Potential Funding Sources	RCC
Timing	Short term (year 1 2020/21)
Location	RCD catchment
Performance Targets	<ul style="list-style-type: none"> • Review complete by June 2021 • Review of NPWS Fire Management Strategy by June 2021

7.2.2 Strategy 5: On-ground Catchment Management Works

Action RC12: RCD Buffer Zone Maintenance

Desired Outcome	Continue to maintain and improve the condition of riparian buffer zones in RCC estate in the vicinity of RCD for continued buffering and protection of drinking water sources.
Priority ranking	High
DESCRIPTION OF TASKS:	
Complete regular maintenance, weed control and enhancement of riparian buffer zones.	
Lead Organisation	RCC
Support Organisation	-
Total Cost Estimate (5year)	n/a
Total RCC Staff Time Estimate (5 year)	Staff time for RCC bush regeneration teams funded under RCC operational budget
Potential Funding Sources	RCC
Timing	On-going (2020-2025)
Location	RCC owned estate in the vicinity of RCD
Performance Targets	<ul style="list-style-type: none"> Maintain condition of buffer zone in RCD catchment

7.2.3 Strategy 1: Engagement, Education and Awareness

Action RC13: On-going Collaboration with NPWS

Desired Outcome	Continue close collaboration with NPWS to ensure on-going effective management for protection of drinking water sources.
Priority ranking	High
DESCRIPTION OF TASKS:	
<ol style="list-style-type: none"> Regular communications with NPWS to effectively manage drinking water catchment areas including consideration of all drinking water risks in decision-making. Renew/update MOU between NPWS and RCC for management and maintenance of land. Communicate risk assessment outcomes and this CMP with NPWS, with reference to controls under the jurisdiction of NPWS. This CMP assumes NPWS controls remain in force. Collaborate with NPWS in the review of the Fire Management Strategy (NPWS, 2005) as discussed in Action RC11: Post-Bushfire Review of Water Quality and Catchment Condition. 	
Lead Organisation	RCC
Support Organisation	NPWS
Total Cost Estimate (5year)	n/a
Total RCC Staff Time Estimate (5 year)	Staff time allocated under existing budgets
Potential Funding Sources	n/a
Timing	On-going (2020-2025)
Performance Targets	<ul style="list-style-type: none"> MOU updated by June 2021

7.3 Wilsons River Source Catchment Actions

There are a number of management actions currently in place to control known water quality risks in the WRS catchment. Action WR14: WRS On-going Catchment Controls lists the current controls that remain in force. Actions WR15-17 detail the additional tasks identified for implementation in the catchment over the next five years.

Action WR14: WRS On-going Catchment Controls

Desired Outcome	Continue current catchment controls to manage risks to drinking water quality.
Priority ranking	Fundamental
DESCRIPTION OF TASKS:	
<ol style="list-style-type: none"> Maintain drinking water catchment signage. The signage includes: (a) drinking water catchment advisory signage with contact number to call in case of contamination incident; (c) educational signage regarding the sensitivity of the local environment. Continue catchment surveillance (refer Action A6: RCC Catchment Surveillance Program). Hazmat spill response including capture, bund, and removal of contaminants by first responders (e.g. RFS, NSW Fire and Rescue). RCC notification of incident by EPA to allow adaptive management and verification testing as necessary. Refer Action A4: Spills and Contamination Emergency Response and Notification Protocol. On-going fire detection and response. Chemical certification required for all RCC staff and contractors undertaking chemical application in the catchment (e.g. for weed control etc.). Implementation of development controls in recognition of the RCC Drinking Water Catchment Overlay providing additional protection for drinking water when local council assesses new developments. RCC to liaise with LCC, BSC and BySC regarding progress and implementation of relevant management plans, strategies and works (i.e. OSSM strategies; stormwater management and improvement; LCC sewer replacement/renewal program; relevant DCPs etc.). RCC to liaise with EPA regarding on-going licensing and regulation of licensed discharges and contaminated land. Adherence to relevant legislation and related regulations and guidelines controlling pollution of the environment and development planning (i.e. <i>Protection of Environment Operations Act 1997</i>; <i>Environmental Planning and Assessment Act 1979</i>; <i>Local Government Act 1993</i>; <i>Contaminated Land Management Act 1997</i>; <i>Pesticides Act 1999</i>; <i>Biodiversity Conservation Act 2016</i>; <i>Soil Conservation Act 1938</i>, <i>National Parks and Wildlife Act 1974</i>). 	
Lead Organisation	RCC
Support Organisation	All catchment stakeholders
Total Cost Estimate (5 year)	No additional costs
Total RCC Staff Time Estimate (5 year)	0.25 EFT (estimate of 0.05 EFT/yr for 5 years)
Potential Funding Sources	RCC
Timing	On-going (2020-2025)
Location	WRS catchment
Performance Targets	<ul style="list-style-type: none"> Refer Action A9: Performance Monitoring and Review of Actions

7.3.1 Strategy 4: Monitoring Evaluation and Reporting

Action WR15: WRS River Reach Plan Audit and Planning

Desired Outcome	Assess progress/current condition of existing River Reach Plan areas Audit new areas and prepare property-scale plans for extension of the River Reach Plan works
Priority ranking	High
DESCRIPTION OF TASKS:	
<p>1. Audit the existing River Reach Plan sites to assess progress/current condition and recommend additional work as required. The assessment will essentially repeat the original assessments completed in 2011 as part of the River Reach Plan development (refer NRCMA, 2011) including:</p> <ol style="list-style-type: none"> Update maps of work completed (this has been undertaken by RCC for most areas and will require minimal additional work to update to current status). Site inspections to assess condition documenting: width of vegetation; types and density of weeds in the canopy, mid-storey and groundcover; native regeneration; stock access; and bank erosion. Drone flyover of sites to document aerial view and allow for repeated drone flights to visually document progress. Determine level of achievement for the expected target condition documented in Northern Rivers Catchment Management Authority- NRCMA (2011) and provide comment on any barriers to success. Based on the above outcomes provide recommendations for further management as required. <p>2. Audit new sites and prepare property-scale site action plans for extension of the River Reach Plan works upstream of the current sites. The audit methodology will essentially repeat the original assessments completed in 2011 as part of the River Reach Plan development (refer NRCMA, 2011). Based on the outcomes of the catchment risk assessment (Appendix 2) the following areas are highlighted for future work:</p> <ol style="list-style-type: none"> Target grazing land and promote the exclusion of stock from accessing waterways (e.g. watercourse fencing, off-stream watering points, improved stock crossings etc.). Improve bank stability. Focus on improving overall habitat condition and maximising land buffering capacity in riparian areas including complete vegetation strata (e.g. groundcovers, mid-strata as well as canopy). 	
Lead Organisation	RCC
Support Organisation	Landholders
Total Cost Estimate (5 year)	\$50,000 (staff time and allowance of \$50,000 for external audit including field inspections and reporting in year 1)
Total RCC Staff Time Estimate (5 year)	0.4 EFT (estimate of 0.4 EFT in year 1)
Potential Funding Sources	RCC
Timing	Short term (year 1 2020/21)
Location	River Reach Plan area and upstream extension along Wilsons River
Performance Targets	<ul style="list-style-type: none"> River Reach Plan Audit completed by June 2021

7.3.2 Strategy 5: On-ground Catchment Management Works

Action WR16: River Reach Plan Extension

Desired Outcome	Continue to improve the condition of riparian buffer zones and adjacent lands for greater buffering and protection of drinking water sources.
Priority ranking	High
DESCRIPTION OF TASKS:	
<p>Based on results of Action WR15: WRS River Reach Plan Audit and Planning, continue, modify and/or extend implementation of River Reach Plans through engagement activities with landholders and on-ground works. Tasks are expected to include:</p> <ol style="list-style-type: none"> 1. Establish landholder agreements. 2. Exclusion of stock from accessing waterways (e.g. watercourse fencing, off-stream watering points, stock crossings etc.). 3. River bank protection works to improve stability and reduce bank erosion. 4. Addressing localised erosion and sedimentation issues through strategic buffer plantings, stock control and support of local erosion control plans. 5. Wherever possible increase the width of the riparian corridor to improve vegetation structure and slow runoff and sedimentation. 6. Create adequate buffers between source waterways and agricultural areas to minimise adverse impacts from agricultural runoff, stock access, farm vehicles, other machinery and spray drift. 7. Connect existing native vegetation through assisted natural regeneration and supplementary plantings in cleared or degraded areas. 8. Utilising the native seed bank to reduce planting costs and enhance use of local provenance species 9. Establishing complete vegetation strata (e.g. groundcovers, mid-strata as well as canopy) to maximise land buffering capacity and improve resilience to future weed invasion through lower light levels. 10. A targeted, systematic approach to managing invasive weeds. 11. Building capacity of landholders to maintain riparian areas from key threats (e.g. invasive weeds, stock access etc.). 	
Lead Organisation	RCC
Support Organisation	Landholders, Local Landcare Groups, North Coast Meat Cooperative (NCCMC)
Total Cost Estimate (5 year)	\$300,000 (allowance of \$75,000 per year from Year 2-5 which equates to River Reach Plan works for an additional 5km over the CMP period including both banks to 25m width).
Total RCC Staff Time Estimate (5 year)	0.6 EFT (estimate of 0.15 EFT in years 2-5)
Potential Funding Sources	RCC
Timing	On-going (2020-2025)
Location	Existing River Reach Plan target area Lismore to Boatharbour
Performance Targets	<ul style="list-style-type: none"> • 5km of River Reach Work completed by June 2025 at priority sites

Action WR17: WRS Buffer Zone Maintenance

Desired Outcome	Continue to maintain and improve the condition of riparian buffer zones in RCC estate in the vicinity of the WRS offtake at Howards Grass for greater buffering and protection of drinking water sources.
Priority ranking	High
DESCRIPTION OF TASKS:	
Complete regular maintenance, weed control and enhancement of riparian buffer zones.	
Lead Organisation	RCC
Support Organisation	-
Total Cost Estimate (5 year)	n/a
Total RCC Staff Time Estimate (5 year)	Staff time for RCC bush regeneration teams funded as operational expense
Potential Funding Sources	RCC
Timing	On-going (2020-2025)
Location	RCC owned estate in the vicinity of the WRS Offtake at Howards Grass
Performance Targets	<ul style="list-style-type: none"> Maintain condition of buffer zone

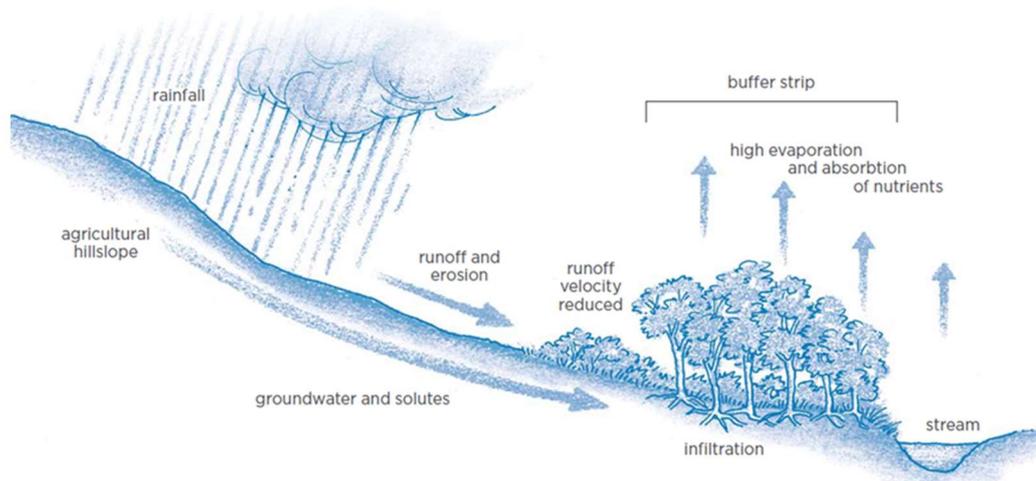


Plate 8: The Wilsons River Reach Plan works adjacent to WRS offtake Top Left: May 2015; Top Right: June 2018; and Below: how a riparian buffer strip functions to protect the stream from contaminants

Source: S.Hood (photos) and RCC (2017)

7.4 Emigrant Creek Dam Catchment Actions

There are a number of management actions currently in place to control known water quality risks in the ECD catchment. Action EC18 lists the current controls that remain in force. Actions EC 19-24 detail the additional tasks identified for implementation in the catchment over the next five years.

Action EC18: ECD On-going Catchment Controls

Desired Outcome	Continue current catchment controls to manage risks to drinking water quality.
Priority ranking	Fundamental
DESCRIPTION OF TASKS:	
<ol style="list-style-type: none"> Maintain drinking water catchment signage. The signage includes: (a) drinking water catchment advisory signage with contact number to call in case of contamination incident; (c) educational signage regarding the sensitivity of the local environment. Continue catchment surveillance (refer Action A6: RCC Catchment Surveillance Program). Hazmat spill response including capture, bund, and removal of contaminants by first responders (e.g. RFS, NSW Fire and Rescue). RCC notification of incident by EPA to allow adaptive management and verification testing as necessary. Refer Action A4: Spills and Contamination Emergency Response and Notification Protocol. On-going fire detection and response. Chemical certification required for all RCC staff and contractors undertaking chemical application in the catchment (e.g. for weed control etc.). Reservoir management undertaken by RCC is in accordance with DWMS (i.e. aeration/destratification, algal alerts, depths of abstraction, customer complaints process, removal or algae from wastewater etc.) Continue to implement formal procedure for the receipt of chemicals at ECD WTP that includes risk management controls for every stage of the chemical delivery process, thereby minimising the risk of spills to stormwater. Implementation of development controls in recognition of the RCC Drinking Water Catchment Overlay providing additional protection for drinking water when local council assesses new developments. RCC to liaise with BSC regarding progress and implementation of relevant management plans, strategies and works (i.e. OSSM strategy implementation etc.). Adherence to relevant legislation and related regulations and guidelines controlling pollution of the environment and development planning (i.e. <i>Protection of Environment Operations Act 1997; Environmental Planning and Assessment Act 1979; Local Government Act 1993; Contaminated Land Management Act 1997; Pesticides Act 1999; Biodiversity Conservation Act 2016; Soil Conservation Act 1938, National Parks and Wildlife Act 1974</i>). 	
Lead Organisation	RCC
Support Organisation	All catchment stakeholders
Total Cost Estimate (5 year)	No additional costs
Total RCC Staff Time Estimate (5 year)	0.25 EFT (estimate of 0.05 EFT/yr for 5 years)
Potential Funding Sources	RCC
Timing	On-going (2020-2025)
Location	ECD catchment
Performance Targets	<ul style="list-style-type: none"> Refer Action A9: Performance Monitoring and Review of Actions

7.4.1 Strategy 4: Monitoring Evaluation and Reporting

Action EC19: ECD River Reach Plan Audit and Planning

Desired Outcome	Assess progress/current condition of existing River Reach Plan areas Audit new areas and prepare property-scale plans for extension of the River Reach Plan works
Priority ranking	High
DESCRIPTION OF TASKS:	
<ol style="list-style-type: none"> 1. Audit the existing River Reach Plan sites to assess progress/current condition and recommend additional work as required. The assessment will essentially repeat the original assessments completed in 2017 as part of the River Reach Plan development (refer RCC, 2017) including: <ol style="list-style-type: none"> a. Update maps of work completed (this has been undertaken by RCC for most areas and will require minimal additional work to update to current status). b. Site inspections to assess condition documenting: width of vegetation; types and density of weeds in the canopy, mid-storey and groundcover; native regeneration; stock access; and bank erosion. c. Drone flyover of sites to document aerial view and allow for repeated drone flights to visually document progress. d. Determine level of achievement for the expected target condition documented in Northern Rivers Catchment Management Authority- NRCMA (2011) and provide comment on any barriers to success. e. Based on the above outcomes provide recommendations for further management as required. 2. Audit new sites and prepare property-scale plans for extension of the River Reach Plan works upstream of the current sites. The audit methodology will essentially repeat the original assessments completed in 2017 as part of the River Reach Plan development (refer RCC, 2017). Based on the outcomes of the catchment risk assessment (Appendix 2) the following areas are highlighted for future work: <ol style="list-style-type: none"> a. Target grazing land and promote the exclusion of stock from accessing waterways (e.g. watercourse fencing, off-stream watering points, improved stock crossings etc.). b. Improve bank stability. 3. Focus on improving overall habitat condition and maximising land buffering capacity in riparian areas including complete vegetation strata (e.g. groundcovers, mid-strata as well as canopy). 	
Lead Organisation	RCC
Support Organisation	Landholders
Total Cost Estimate (5 year)	\$50,000 (staff time and allowance of \$50,000 for external audit including field inspections and reporting in year 1)
Total RCC Staff Time Estimate (5 year)	0.4 EFT (estimate of 0.4 EFT in year 1)
Potential Funding Sources	RCC
Timing	Short term (2020/21)
Location	River Reach Plan area and upstream extension along Wilsons River
Performance Targets	<ul style="list-style-type: none"> • River Reach Plan Audit completed by June 2021

7.4.2 Strategy 5: On-ground Catchment Management Works

Action EC20: River Reach Plan Extension

Desired Outcome	Continue to improve the condition of riparian buffer zones and adjacent lands for greater buffering and protection of drinking water sources.
Priority ranking	High
DESCRIPTION OF TASKS:	
<p>Based on results of Action EC19: ECD River Reach Plan Audit and Planning, continue, modify and/or extend implementation of River Reach Plans through engagement activities and on-ground works as suitable. Tasks are expected to include:</p> <ol style="list-style-type: none"> 1. Establish landholder agreements. 2. Exclusion of stock from accessing waterways (e.g. watercourse fencing, off-stream watering points, stock crossings etc.). 3. River bank protection works to improve stability and reduce bank erosion. 4. Addressing localised erosion and sedimentation issues through strategic buffer plantings, stock control and support of local erosion control plans. 5. Wherever possible increase the width of the riparian corridor to improve vegetation structure and slow runoff and sedimentation. 6. Create adequate buffers between source waterways and agricultural areas to minimise adverse impacts from agricultural runoff, stock access, farm vehicles, other machinery and spray drift. 7. Connect existing native vegetation through assisted natural regeneration and supplementary plantings in cleared or degraded areas. 8. Utilising the native seed bank to reduce planting costs and enhance use of local provenance species 9. Establishing complete vegetation strata (e.g. groundcovers, mid-strata as well as canopy) to maximise land buffering capacity and improve resilience to future weed invasion through lower light levels. 10. A targeted, systematic approach to managing invasive weeds. 11. Building capacity of landholders to maintain riparian areas from key threats (e.g. invasive weeds, stock access etc.). 	
Lead Organisation	RCC
Support Organisation	Landholders
Total Cost Estimate (5 year)	\$240,000 (allowance of \$60,000 per year from Year 2-5 which equates to River Reach Plan works for an additional 4km (both banks to 25m width) over the CMP period). This will complete the main channel reach upstream of the Pacific Highway to the top of catchment.
Total RCC Staff Time Estimate (5 year)	0.6 EFT (estimate of 0.15 EFT in years 2-5)
Potential Funding Sources	RCC
Timing	On-going (2020-2025)
Location	River Reach Plan area ECD to Pacific Highway and extending upstream of Highway
Performance Targets	<ul style="list-style-type: none"> • 4km of River Reach Work completed by June 2025.

Action EC21: ECD Buffer Zone Maintenance

Desired Outcome	Continue to maintain and improve the condition of riparian buffer zones in RCC estate in the vicinity of ECD for greater buffering and protection of drinking water sources.
Priority ranking	High
DESCRIPTION OF TASKS:	
Complete regular maintenance, weed control and enhancement of riparian buffer zones.	
Lead Organisation	RCC
Support Organisation	-
Total Cost Estimate (5 year)	n/a
Total RCC Staff Time Estimate (5 year)	Staff time for RCC bush regeneration teams funded under RCC operational budget
Potential Funding Sources	RCC
Timing	On-going (2020-2025)
Location	RCC owned estate in the vicinity of ECD
Performance Targets	<ul style="list-style-type: none"> Maintain condition of buffer zone in ECD catchment



Plate 9: Emigrant Creek Dam Catchment Reach Plan works Left: Oct 2017; Right: Jan 2019

Source: S.Hood

Action EC22: Trial Farm-Based Erosion Management Plans

Desired Outcome	Establish a trial site for a farm-based erosion management plan in collaboration with the AMS to address sediment export from macadamia orchards.
Priority ranking	High
DESCRIPTION OF TASKS:	
<p>1. Revisit previous partnership between RCC and the AMS to attract funding for macadamia orchard erosion. The previous program aimed to produce farm-based erosion management plans to address sediment export. The following tasks are required:</p> <ol style="list-style-type: none"> a. Engage with AMS to discuss the proposed work and potential for implementation, funding opportunities and sites etc. b. RCC to make a monetary co-contribution for the project with anticipated benefit for source water protection. c. Select an initial trial site to allow for a small-scale on-ground assessment of the impact of such works on water source protection. d. Develop farm-based erosion management plan e. Implement works. f. Monitor site. g. Report results. <p>2. Based on results, assess the effectiveness of works and recommend next steps.</p>	
Lead Organisation	RCC
Support Organisation	Landholders , AMS
Total Cost Estimate (5 year)	\$50,000 (allowance of \$50,000 for RCC co-contribution assuming successful grant application and funding secured from Hort Innovation funding)
Total RCC Staff Time Estimate (5 year)	0.15 EFT (estimate of 0.15 EFT in year 3)
Potential Funding Sources	RCC, Hort Innovation funding, AMS
Timing	Medium term (year 3 2022/23)
Location	ECD Catchment
Performance Targets	<ul style="list-style-type: none"> • On-ground works completed by June 2023.

7.4.3 Strategy 1: Engagement, Education and Awareness

Action EC23: Pesticide Notification

Desired Outcome	Landholders implement the Australian Macadamia Society (AMS) best-practice guidelines regarding pesticide notifications.
Priority ranking	High
DESCRIPTION OF TASKS:	
1. RCC to work together with the Australian Macadamia Society (AMS) to encourage application of best-practice guidelines regarding pesticide notifications. The <i>Best Practice Guidelines for Application of Chemicals in Macadamia Orchards</i> (AMS, 2011) provides guidelines to notify neighbours of planned pesticide use using an appropriate method that makes sense for all (refer section 1.3 of the guidelines).	
Lead Organisation	RCC
Support Organisation(s)	AMS, Catchment Landholders and Fam Managers
Total Cost Estimate (5 year)	n/a
Total RCC Staff Time Estimate (5 year)	0.025 EFT (estimate of 0.025 EFT in year 1)
Potential Funding Sources	n/a
Timing	On-going (2020-2025)
Performance Targets	<ul style="list-style-type: none"> Collaboration with AMS commenced by June 2021

7.5 Proposed Dunoon Dam Catchment Management Actions

7.5.1 Strategy 5: On-ground Catchment Management Works

Action DD24: DD Buffer Zone Maintenance

Desired Outcome	Continue to maintain and improve the condition of riparian buffer zones in RCC estate in the vicinity of the potential DD.
Priority ranking	High
DESCRIPTION OF TASKS:	
<ol style="list-style-type: none"> 1. Complete regular maintenance, weed control and enhancement on RCC land. 2. For areas under agistment, ensure that agistment agreements include requirements for appropriate management of stock and land to prevent erosion and land degradation and management of priority weeds as required under the <i>Biosecurity Act 2015</i>. 	
Lead Organisation	RCC
Support Organisation	-
Total Cost Estimate (5 year)	n/a
Total RCC Staff Time Estimate (5 year)	Staff time for RCC bush regeneration teams funded under RCC operational budget
Potential Funding Sources	RCC
Timing	On-going (2020-2025)
Location	RCC owned estate in DD catchment
Performance Targets	<ul style="list-style-type: none"> • Maintain condition of buffer zone in DD catchment



Plate 10: Left: RCC planting works Right: Wilsons River near Federal

Source: www.rous.nsw.gov.au

8. BUSINESS PLAN

The business plan outlines the key components of the CMP, including the timing and cost of the proposed actions.

The business plan specifies:

- Action ID number and name.
- Priority ranking.
- Cost estimate.
- Timing.

Table 9: Catchment Management Business Plan

Strategy/Action/Year	Priority Ranking	Total 5 year cost	DP1	DP2				
			Year 1	Year 2	Year 3	Year 4	Year 5	
		\$'000	2020/21	2021/22	2022/23	2023/24	2024/25	
Engagement, Education and Awareness								
Action A1: Catchment Landholder Education and Awareness	High	175	35	35	35	35	35	
Planning and Policy Review								
Action A2: OSSM System Planning and Policy Review	Medium	50			50			
Action A3: Development Planning and Policy Review	Medium	60			60			
Emergency Planning and Response								
Action A4: Spills and Contamination Emergency Response and Notification Protocol	High	0	no additional cost					
Monitoring Evaluation and Reporting								
Action A5: RCC Catchment Water Quality Monitoring Program	Fundamental	50	8	33	3	3	3	
Action A6: RCC Catchment Surveillance Program	Fundamental	0	no additional cost					
Action A7: Intensive Pesticide Sampling Program	High	75		75				
Action A8: Investigate Potentially Harmful Contaminants	Medium	24		12	12			
Action A9: Performance Monitoring and Review of Actions	Fundamental	0	no additional cost					
Rocky Creek Dam Catchment Actions								
Action RC10: RCD On-going Catchment Controls	Fundamental	0	no additional cost					
Action RC11: Post-Bushfire Review of Water Quality and Catchment Condition	Medium	10	5	5				
Action RC12: RCD Buffer Zone Maintenance	High	0	no additional cost					
Action RC13: On-going Collaboration with NPWS	Fundamental	0	no additional cost					

Strategy/Action/Year	Priority Ranking	Total 5 year cost	DP1	DP2				
			Year 1	Year 2	Year 3	Year 4	Year 5	
		\$'000	2020/21	2021/22	2022/23	2023/24	2024/25	
Wilsons River Source Catchment Actions								
Action WR14: WRS On-going Catchment Controls	Fundamental	0	no additional cost					
Action WR15: WRS River Reach Plan Audit and Planning	Fundamental	50	50					
Action WR16: River Reach Plan Extension	High	300		75	75	75	75	
Action WR17: WRS Buffer Zone Maintenance	Medium	0	no additional cost					
Emigrant Creek Dam Catchment Actions								
Action EC18: ECD On-going Catchment Controls	Fundamental	0	no additional cost					
Action EC19: ECD River Reach Plan Audit and Planning	Fundamental	50	50					
Action EC20: River Reach Plan Extension	High	240		60	60	60	60	
Action EC21: ECD Buffer Zone Maintenance	Medium	0	no additional cost					
Action EC22: Trial Farm-Based Erosion Management Plans	High	50			50			
Action EC23: Pesticide Notification	High	0	no additional cost					
Potential Dunoon Dam Catchment Actions								
Action DD24: DD Buffer Zone Maintenance	Low	0	no additional cost					
TOTALS		1134	148	295	345	173	173	

Notes: Years correspond to financial year i.e. 2020/21 is Year 1 (start 1st July 2020, end 30th June 2021) etc.

9. REFERENCES

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GLOSSARY AND ABBREVIATIONS

ADWG	Australian Drinking Water Guidelines
AMS	Australian Macadamia Society
ANZECC	Australian and New Zealand Environment and Conservation Council- provided governments and communities with a set of tools for assessing and managing ambient water quality and sediment quality in natural and semi-natural water resources.
Aquatic	Living or growing in water, not on land.
BOM	Bureau of Meteorology
BSC	Ballina Shire Council
BySC	Byron Shire Council
CMP	Catchment Management Plan
CZMP	Coastal Zone Management Plan
DD	Dunoon Dam
Dissolved Oxygen	Oxygen dissolved in the water (oxygen saturation). Often abbreviated to DO
DP	Council's four year Delivery Program
DPI Fisheries	Department of Planning, Industry and Environment Regions, Industry, Agriculture and Resources Department of Primary Industries Fisheries
DPIE	NSW Department of Planning Industry and Environment
DPIE – Crown Lands	Department of Planning, Industry and Environment, Crown Lands (formerly DI Lands)
DWMS	Drinking Water Management System
ECD	Emigrant Creek Dam
EDC	Endocrine Disrupting Chemical – substances in the environment (air, soil, or water supply), food sources, personal care products, and manufactured products that interfere with the normal function of your body's endocrine system.
Ecology	The interactions between organisms and their environment
Ecosystem	Refers to all the biological and physical parts of a biological unit (e.g. an estuary, forest, or planet) and their interconnections.
EES – Coast and Estuaries	Department of Planning, Industry and Environment – Environment, Energy and Science – Coast and Estuaries, formerly known as OEH Coasts and Estuaries
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	NSW Environmental Protection Agency
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
Hazmat	A material (such as flammable or poisonous material) that would be a danger to life or to the environment if released without precautions
Hydrology	The study of water and its properties, including precipitation onto land and returning to oceans

IP&R	NSW Integrated Planning and Reporting Framework
LCC	Lismore City Council
LEP	Local Environmental Plan
LGA	Local Government Area
LLS	Local Land Services
MEMA	Marine Estate Management Authority
MOU	Memorandum of Understanding
NCMC	North Coast Meat Cooperative
NHMRC	National Health and Medical Research Council
NPWS	National Parks and Wildlife Service
NRMMC	Natural Resource Management Ministerial Council
OEH	Office of Environment and Heritage (now EES- Coasts and Estuaries)
RCC	Rous County Council
RCD	Rocky Creek Dam
RFS	Rural Fire Service
Riparian	Of, on or relating to the banks of a watercourse
RMS	Roads and Maritime Services
Terrestrial	Living or growing on land (not aquatic)
Turbid	Cloudy or dirty (not clear)
Turbidity	A measure of the amount of light-attenuating particles in a water body.
WRS	Wilson's River Source
WTP	Water Treatment Plant

Appendix 1. STATUS OF EXISTING RCC CATCHMENT MANAGEMENT PLAN (CMP) ACTIONS

Appendix 2. RCC DRINKING WATER CATCHMENTS RISK ASSESSMENT 2020

Appendix 3. PROJECTS THAT ARE NOT FUNDED IN THE CMP

Table 10: Business Plan for unfunded projects

Strategy/Action/Year	Priority Ranking	Total 5 year cost \$'000	DP1	DP2				
			Year 1	Year 2	Year 3	Year 4	Year 5	
			2020/21	2021/22	2022/23	2023/24	2024/25	
Engagement, Education and Awareness								
Action U25: Community Carp Muster	Low	20				10	10	

LISMORE RIVER FESTIVAL AND CARP MUSTER

Conservation Volunteers Australia

The Northern Rivers are suffering from a pest fish invasion!

Come along to the Lismore River Festival and Carp Muster to find out more about river health, catch some carp and be in the running to win great prizes.

FREE EVENT

When: Saturday December 2 from 10 am

Where: Riverside Park, Lismore

Over \$2000 in prizes on offer including Junior and Senior Biggest Bag, Mystery Raffle and more!

FESTIVAL EVENTS AND ACTIVITIES

- Fishing from the riverbank - BYO fishing gear and fishing license
- Carp weigh-ins with prizes
- Carp filleting and cooking demonstrations and tastings
- Tree planting
- Catchment health education and games
- Talks from carp and river health experts
- Kids activities
- Live music

FESTIVAL DISPLAYS

- Lismore City Council
- Lismore SES
- Northern Rivers Science Hub
- Richmond Landcare
- Frogleys Offshore
- Ballina Fishermans Co-Op
- Rous County Council
- Lismore Rainforest Botanic Gardens
- Far North Coast Canoe Club

PARTNERS

BIODIVERSITY MANAGEMENT STRATEGY
NSW
NSW Environmental Trust
Fish UNLIMITED
Carp Image: NSW DPI

For more information, contact us:
Conservation Volunteers Australia
02 6681 6169
www.cva.org.au

Plate 11: Lismore River Festival and Carp Muster flyer 2017

Source: <https://conservationvolunteers.com.au/news/2017/11/lismore-river-festival-carp-muster/>

Action U25: Community Carp Muster

Desired Outcome	Establish an annual community Carp Muster event to promote awareness about the pest species and decrease numbers in drinking water catchments.
Priority ranking	Low
DESCRIPTION OF TASKS:	
<ol style="list-style-type: none"> 1. Determine details of the Carp Muster including: <ol style="list-style-type: none"> a. Locations (e.g. Wilsons River tidal pool, ECD) b. Timing (Spring may present low flow periods and fine weather suitable for the event) c. Rules and regulations including: <ol style="list-style-type: none"> i. Registration, ii. Fishing licence requirements, iii. Equipment (e.g. rods, reel and handlines in accordance with NSW rules and regulations), iv. By-catch best practice (catch and release), v. Weigh-in rules. d. Prizes and categories (e.g. cash/vouchers or products) in age groups etc. e. Investigate any potential safety and/or liability issues. 2. Consultation with DPI Fisheries regarding the event and any special requirements. 3. Develop promotional material and advertising. 4. Run pilot program (trial). 5. Assess success of the pilot and determine repeat events as appropriate. 	
Lead Organisation	RCC
Support Organisation(s)	DPI-Fisheries LCC OzFish Relevant businesses (e.g. Ballina Fishermans Co-op, angling outlets etc.) General public
Total Cost Estimate (5 year)	\$40,000 (staff / stakeholder time and allowance of \$10,000 per year for implementation (e.g. media, prizes and event costs)
Potential Funding Sources	RCC, DPI-Fisheries
Timing	Year 2 - 5
Performance Targets	<ul style="list-style-type: none"> • Carp Muster pilot held by Dec 2022