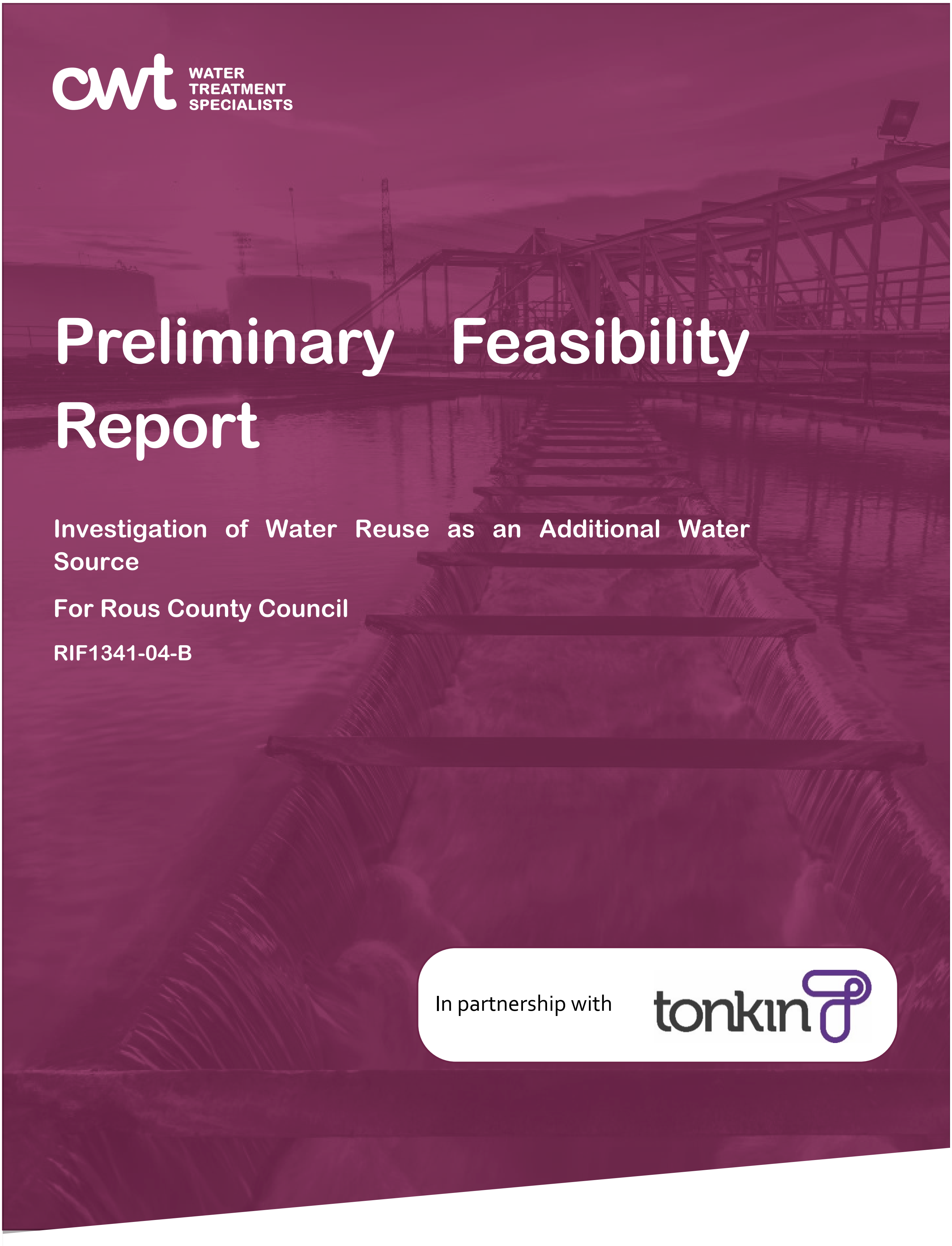

WATER TREATMENT SPECIALISTS

Preliminary Feasibility Report

Investigation of Water Reuse as an Additional Water Source

For Rous County Council

RIF1341-04-B

In partnership with tonkin

29 May 2020

Preliminary Feasibility Report

For Rous County Council

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5/03/2020	A	RCC	NO/MW/BS/PS	JO/NP	For discussion at the workshop
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Contents

Figures

Tables

Abbreviations and Notations

Acronym	Meaning
ADWG	Australian Drinking Water Guidelines
AGWR	Australian Guidelines for Water Recycling
AWRP	Advanced Water Recycling Plant
AWTP	Advanced Water Treatment Plant
BOD	Biological Oxygen Demand
BSC	Ballina Shire Council
BySC	Byron Shire Council
Cl_2	Chlorine
DA	Development Application
DAF	Dissolved air flotation
DALY	Disability adjusted life years
DPIE	Department of Planning, Industry and Environment
E. Coli	Escherichia coli
EHB	Effluent Holding Basin
EIS	Environmental Impact Statement
EP	Equivalent Persons
EP&A	Environment Planning and Assessment
EPA	Environment Protection Authority
GL	Giga (billion) litres
H_2O_2	Hydrogen peroxide
IPR	Indirect Potable Reuse
IWCM	Integrated Water Cycle Management
kL	Kilolitre
LCC	Lismore City Council
LEP	Local Environmental Plan
LG Act	Local Government Act
LG Regulation	Local Government Regulation
LGA	Local Government Area
LRV	Log reduction value
mg/L	Milligrams per litre
ML	Mega (million) litres
ML/a	Mega litres per annum
NH_3-N	Nitrogen as ammonia

Acronym	Meaning
PH Act	Public Health Act
POEO	Protection of the Environment Operations
RCC	Rous County Council
RO	Reverse osmosis
SEO	South Eastern Outfall
SEPP	State Environmental Planning Policy
SMBS	Sodium metabisulfite
STP	Sewage Treatment Plant
TPAD	Thermophilic anaerobic digestion
UF	Ultrafiltration
UV	Ultraviolet
WICA	Water Industry Competition Act
WMA	Water Management Act
WWTP	Wastewater Treatment Plant

1 Introduction

Rous County Council (RCC) is the regional water supply authority providing bulk supply of drinking water to consumers in the Local Government Areas (LGAs) of Lismore, Ballina, Byron and Richmond Valley.

RCC currently source their potable water supplies from three main sources: Rocky Creek Dam, Wilson River and Emigrant Creek Dam as outlined in Figure 1-1 below.

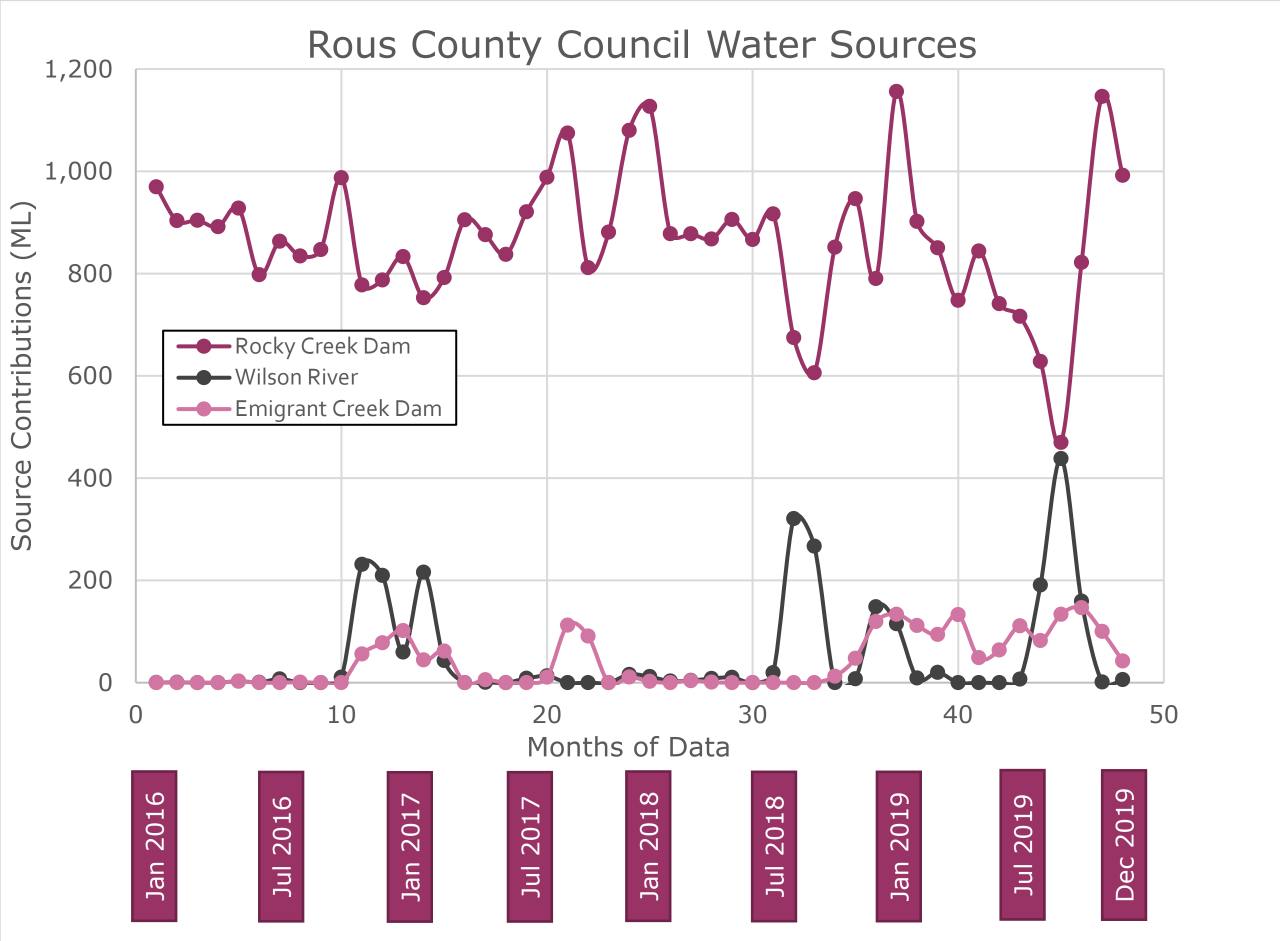


Figure 1-1 Rous County Council Existing Potable Water Sources

In 2014, RCC adopted a Future Water Strategy (IWCM) which outlined three key actions to ensure future water security, these are:

- Key action 1 — Maximise water efficiency through demand management and conservation.
- Key action 2 — Investigate increased use of groundwater as a new water source.
- Key action 3 — Investigate the suitability of water reuse as an additional new water source.

This desktop study focuses on Key Action 3, identifying and assessing effluent availability and reuse opportunities with the aim to reduce or replace potable water demand within areas supplied by RCC.

Within the areas RCC supply with potable water, the local councils operate their own wastewater treatment plants. RCC has provided previous reporting and available flow and water quality data for each of these treatment plants. A high-level overview of the plants and their potential for reuse is discussed in Chapter 2 of this report. Selected treatment plants identified to have good potential to provide source volumes for water reuse are further analysed in Chapter 5.

A previous study for RCC has acknowledged that there is a range of existing water reuse schemes surrounding the WWTPs nominated, which currently utilise some of the available treated effluent. This study incorporates a summary of both existing water reuse and water reuse planned by the relevant councils to inform the analysis of available effluent water for reuse. Once existing and planned water reuse schemes have been accounted for, the remaining available water may be considered for additional reuse opportunities which have potential to reduce potable demands. In this study, we have also considered indirect potable reuse as another option for enhanced water security.

2 Overview of Current Schemes

The WWTPs within RCC's supply area are listed below. The plants RCC has nominated as potential water sources for potable demand reduction schemes are indicated in italics.

Table 2-1: Overview of Constituent Council Wastewater Treatment Plants and Discharge Allowances (based on EPA Licences)

Council	WWTP	Maximum Allowable Discharge Volume
Ballina	*Ballina*	▲ *1,000 – 5,000 ML per year* ▲ *9,600 kL per day*
	Lennox Head	▲ *1,000 – 5,000 ML per year* ▲ *26,880 kL per day*
	Alstonville	▲ *219 – 1,000 ML per year* ▲ *7,680 kL per day*
	Wardell (not serviced by RCC)	▲ 100 -219 ML per year ▲ 1680 kL per day
Byron	Byron Bay	▲ 1000 - 5000 ML per year ▲ 48 650 kL per day
	Brunswick Valley	▲ 1,000 – 5,000 ML per year ▲ 22,040 kL per day
	Bangalow	▲ *219 – 1,000 ML per year* ▲ *5,950 kL per day*
Richmond Valley	Casino (not serviced by RCC)	▲ 1,000 – 5,000 ML per year ▲ 35,500 kL per day
	Evans Head	▲ 219 - 1000 ML per year ▲ 6,500 kL per day
	Coraki	▲ 100 -219 ML per year ▲ 1,296 kL per day
Lismore	*South Lismore*	▲ *1000 - 5000 ML per year* ▲ *24,000 kL per day*
	East Lismore	▲ *1,000 – 5,000 ML per year* ▲ *22,000 kL per day*
	Nimbin (not serviced by RCC)	▲ 20 -100 ML per year ▲ 2,400 kL per day

Table 2-1 above indicates that the maximum allowable effluent discharge from the plants considered in this study is approximately 22,000 ML/year. In comparison, for the calendar years 2016-2018, Rous County Council indicated they consumed 9,000-12,000 ML/year in source water for the production of drinking water. At a high level this indicates there are significant effluent volumes available for potential offset of potable water demands. This is discussed further in section 5.

2.1 Ballina Shire Council

Ballina Shire Council (BSC) has 3 treatment plants within the RCC supply area and all of these have been identified as having potential to provide an effluent source for water savings. Details of the treatment plants are listed below. BSC also operates a fourth WWTP at Wardell, but this plant is outside the RCC service area and therefore has not been considered further.

2.1.1 Ballina WWTP

2.1.1.1 Scheme Summary

Table 2-2 Ballina WWTP Summary

Item	Details		
Population Serviced	15,000		
Waste Water Treatment Plant			
Design Flow	5.4 ML/d (increasing to 6.91 ML/d after Stage 1 upgrades)		
Design Equivalent Persons (EP)	30,000		
Total Effluent Flow	2,500 – 3,500 ML/year		
Treatment Process	▲ Drum screens ▲ Vortex chamber ▲ Aerobic digester ▲ Anaerobic digester ▲ Membrane filtration ▲ UV disinfection ▲ Chlorination ▲ Sludge drying		
EPA Licence Conditions	**Parameter**	**Unit**	**Maximum Concentration Limit**
	Volume	kL/day	9,600
	BOD	mg/L	20
	Coliforms	cells/mL	600
	NH3-N	mg/L	5
	Oil and Grease	mg/L	10
	pH		6.5 – 8.5
	Suspended solids	mg/L	30
	Total phosphorus	mg/L	1
Effluent Discharge Location	▲ Ocean via Fishery Creek		

Item	Details
Recycled Water Schemes	
Current Reuse	No recycled water used since 2017
Projected Reuse	Up to 80% (dry weather flow)
Intended End Use	▲ Residential – dual reticulation ▲ Urban open spaces – parks, ovals, etc. ▲ Irrigation ▲ Commercial and industrial operations

2.1.1.2 Effluent Water Quality

Table 2-3 Ballina WWTP Effluent Water Quality (Aug 2018 - Aug 2019)

Parameter	Units	Count	Min	Mean	90th %ile	Max
BOD	mg/L	17	1	2.824	4.4	8
Coliforms	cells/100 mL	32	2.4	17.225	31.9	64
NH3-N	mg/L	17	0.035	0.138	0.2594	0.351
Oil and Grease	mg/L	17	1	1.227	1.732	3.03
pH		17	7.4	7.774	7.924	7.97
Suspended Solids	mg/L	17	1	6.253	11.2	38.8
Total nitrogen	mg/L	17	1.346	3.636	5.1434	7.689
Total phosphorus	mg/L	17	0.039	0.204	0.3826	0.445

The highlighted cell in the table above indicates an exceedance of the Ballina WWTP's EPA Licence Conditions.

- High suspended solids can be indicative of poor filtration performance and can affect efficacy of disinfection.

The operation and performance of the WWTP should be optimised. Suspended solids are routinely removed by conventional water treatment processes, but can also be removed at an AWRP with further treatment such as membrane filtration.

2.1.2 Lennox Head WWTP

2.1.2.1 Scheme Summary

<table>
<tr><th>Item</th><th>Details</th></tr>
<tr><td>Population Serviced</td><td>6,732</td></tr>
<tr><td colspan="2">Waste Water Treatment Plant</td></tr>
<tr><td>Design EP</td><td>18,000 EP</td></tr>
<tr><td>Total Effluent Flow</td><td>1,400 – 1,700 ML/year</td></tr>
<tr><td>Treatment Process</td><td>▲ Step screens
▲ Grit remover
▲ Classifier
▲ Deodorising bed
▲ Aerators
▲ Membrane filtration of water for reuse
▲ UV disinfection
▲ Sludge ponds</td></tr>
<tr><td>EPA Licence Conditions</td><td><table>
<tr><th>Parameter</th><th>Unit</th><th>Maximum Concentration Limit</th></tr>
<tr><td>Volume</td><td>kL/day</td><td>26,880</td></tr>
<tr><td>BOD</td><td>mg/L</td><td>20</td></tr>
<tr><td>Coliforms</td><td>cells/mL</td><td>600</td></tr>
<tr><td>Oil and Grease</td><td>mg/L</td><td>10</td></tr>
<tr><td>pH</td><td></td><td>6.5 – 8.5</td></tr>
<tr><td>Suspended solids</td><td>mg/L</td><td>30</td></tr>
</table></td></tr>
<tr><td>Effluent Discharge Location</td><td>▲ Ocean outfall</td></tr>
<tr><td colspan="2">Recycled Water Schemes</td></tr>
<tr><td>Current Reuse</td><td>~30%</td></tr>
<tr><td>Projected Reuse</td><td>80% by 2026</td></tr>
<tr><td>Intended End Use</td><td>▲ Urban open spaces – golf courses, parks;
▲ Residential – housing estates</td></tr>
</table>

2.1.2.2 Effluent Water Quality

No water quality data was available for Lennox Head WWTP.

2.1.3 Alstonville WWTP

2.1.3.1 Scheme Summary

Table 2-4 Alstonville WWTP Scheme Summary

Item	Details		
Population Serviced	6,000		
Waste Water Treat Plant			
Design Flow	1.3 ML/d		
Total Effluent Flow	600 – 750 ML/year		
Treatment Process	▲ Step screens ▲ Grit arrester ▲ Chemical dosing ▲ Aeration tanks ▲ Chlorination ▲ UV disinfection ▲ Balancing ponds		
EPA Licence Conditions	**Parameter**	**Unit**	**Maximum Concentration Limit**
	Volume	kL/day	7,680
	BOD	mg/L	20
	Coliforms	cells/mL	600
	Oil and Grease	mg/L	10
	pH		6.5 – 8.5
	Suspended solids	mg/L	30
	Total nitrogen	mg/L	20
	Total phosphorus	mg/L	1.0
Effluent Discharge Location	▲ Maguires Creek		
Recycled Water Schemes			
Current Reuse	Up to 50% (2018/19)		
Projected Reuse	80 – 100% (2013)		
Intended End Use	▲ Urban open spaces – playing fields ▲ Irrigation – nurseries, farms		

2.1.3.2 Effluent Water Quality

Table 2-5 Alstonville WWTP Effluent Water Quality (Aug 2018 - Aug 2019)

Parameter	Units	Count	Min	Mean	90th %ile	Max
BOD	mg/L	17.00	2.00	5.35	9.00	12.00
Coliforms	cells/100 mL	16.00	0.50	2.00	3.50	17.00
Oil and Grease	mg/L	17.00	1.00	1.07	1.00	2.22
pH		18.00	7.54	9.04	10.19	10.34
Total nitrogen	mg/L	17.00	1.87	3.73	5.30	6.67
Total phosphorus	mg/L	17.00	0.11	0.43	0.74	0.85
Suspended solids	mg/L	17.00	1.00	15.44	31.80	39.00

The highlighted cells in the table above indicate parameters which exceed the WWTP's EPA Licence Conditions.

- High suspended solids can be indicative of poor settling/aeration
- High nitrogen and pH can be indicative of poor secondary treatment

The performance of the WWTP should be optimised to minimise these parameters, particularly improving the removal of nitrogen. Suspended solids and pH can be addressed as part of conventional water treatment however, advanced treatment processes such as ion exchange or RO would be required to remove nitrogen, increasing infrastructure requirements and capital expenditure.

2.2 Byron Shire Council

Byron Shire Council (BySC) has 3 treatment plants within the RCC service area, 1 of which (Bangalow WWTP) has been identified as being a potential effluent source to provide water savings. Details of Bangalow WWTP are listed below.

2.2.1 Bangalow WWTP

2.2.1.1 Scheme Summary

Table 2-6 Bangalow WWTP Scheme Summary

Item	Details
Population Serviced	1,550
Waste Water Treatment Plant	
Design Flow	2.5 ML/day
Total Effluent Flow	140 – 170 ML/year
Treatment Process	Pre-treatment screening; Anoxic and aerobic bioreactors; Membrane bioreactors; UV disinfection;

Item	Details		
EPA Licence Conditions	Parameter	Unit	Maximum Concentration Limit
	Volume	kL/day	5,950
	BOD	mg/L	20
	Coliforms	cells/mL	600
	NH_3-N	mg/L	5
	Oil and Grease	mg/L	10
	pH		6.5 – 8.5
	Suspended solids	mg/L	30
	Total nitrogen	mg/L	15
	Total phosphorus	mg/L	1
Effluent Discharge Location	▲ Maori Creek		
Recycled Water Schemes			
Current Reuse	Up to 13% (no reuse recorded in the 2016 – 2019 period)		
Projected Reuse (by 2027)	100%		
Intended End Use	▲ Wetlands ▲ Biomass crops ▲ On-site bamboo plantation		

2.2.1.2 Effluent Water Quality

Table 2-7 Bangalow WWTP Effluent Water Quality (Apr 2015 - Nov 2019)

Parameter	Units	Count	Min	5th percentile	Mean	90th %ile	Max
Aluminium	mg/L	42	0.02	0.03	0.07	0.10	0.41
BOD	mg/L	74	0.00	0.00	0.83	1.34	10.20
Coliforms	CFU/100 mL	74	0.00	0.00	2.54	6.00	24.00
NH_3-N	mg/L	74	0.00	0.00	0.41	0.30	12.34
Oil & Grease	mg/L	74	0.00	0.00	1.20	2.00	6.00
pH		73	6.70	6.80	7.19	7.5	8.10
Suspended solids	Mg/L	74	0.00	0.00	0.65	1.94	3.50
Total phosphorus	mg/L	73	0.94	1.20	3.12	8.69	13.69

The highlighted cells in the table above indicate parameters which exceed the WWTP's EPA Licence Conditions.

▲ High nitrogen and phosphorous can be indicative of poor secondary treatment.

The WWTP operation and performance should be optimised to minimise phosphorous and nitrogen in the treated effluent. Conventional water treatment (media filtration, UV) does not reduce these parameters, however advanced treatment processes like reverse osmosis (often used as part of IPR) can be used to remove these.

2.2.2 Byron Bay and Brunswick WWTPs

Byron Bay and Brunswick WWTPs have not been considered as part of this feasibility assessment due to their remote location. The areas surrounding these WWTPs is dominated by national parks and conservation areas, further increasing the complexity of delivering treated effluent to nearby raw water sources. There are also significant elevation changes, Rocky Creek Dam, sits at 200 m above sea level, whilst the WWTPs are close to sea level meaning transport of effluent or recycled water would introduce significant hydraulic considerations and operating expense.

2.3 Richmond Valley Council

Richmond Valley Council operates two WWTPs within the area serviced by RCC, Coraki and Evans Head WWTP. Casino WWTP is not within the supply area for RCC as has not been considered further.

Based on their geographic separation from other WWTPs and raw water sources for RCC, it has been determined that the use of these two WWTPs as sources of recycled water is unlikely to be feasible.

Based on the EPA licence discharge volumes, it can also be seen that Coraki WWTP only services a small population and would not provide a significant source for recycled water. Evans Head, whilst servicing a slightly larger population is the furthest WWTP from any raw water source and unlikely to be a feasible source of recycled water. These WWTPs have not been considered further for inclusion in this study.

2.4 Lismore City Council

Lismore City Council operates East Lismore WWTP, South Lismore WWTP and Nimbin WWTP. Nimbin WWTP is not within the supply area of RCC and therefore has not been considered further.

2.4.1 South Lismore WWTP

2.4.1.1 Scheme Summary

Table 2-8 South Lismore WWTP Scheme Summary

Item	Details
Waste Water Treatment Plant	
Design Flow	7.5 ML/d
Design EP	22,000
Total Effluent Flow	800-1,200 ML/year
Treatment Process	▲ IDEA Reactors ▲ Digesters ▲ Cloth Media Filters ▲ UV ▲ Sludge Dewatering

Item	Details		
EPA Licence Conditions	**Parameter**	**Unit**	**Maximum Concentration Limit**
	Volume	kL/day	24,000
	BOD	mg/L	25
	Coliforms	cells/mL	600
	Nitrogen (ammonia)	mg/L	5
	Nitrogen (total)	mg/L	20
	Oil and Grease	mg/L	10
	pH		6.5 – 8.5
	Suspended solids	mg/L	30
	Total phosphorus	mg/L	1
Effluent Discharge Location	▲ Hollingsworth Creek		
Recycled Water Schemes			
Current Reuse	No recycled water used		
Projected Reuse (by 2027)	None planned		
Intended End Use	▲ None		

2.4.1.2 Effluent Water Quality

No water quality data was available for South Lismore WWTP.

2.4.2 East Lismore WWTP

2.4.2.1 Scheme Summary

Item	Details		
Waste Water Treatment Plant			
Design Flow	5.28		
Design EP	31,250		
Total Effluent Flow	1,500-3,000 ML/year		
Treatment Process	▲ Balance Tank ▲ Screening and Grit Removal ▲ Sedimentation Tanks ▲ Anaerobic/Anoxic Reactors ▲ IDEA Tanks ▲ Tertiary Lagoon ▲ Digesters, WAS thickening and sludge dewatering		
EPA Licence Conditions	**Parameter**	**Unit**	**Maximum Concentration Limit**
	Volume	kL/day	22,000
	BOD	mg/L	35

Item	Details		
	Nitrogen (ammonia)	mg/L	10
	Nitrogen (total)	mg/L	25
	Oil and Grease	mg/L	10
	pH		6.5 – 8.5
	Suspended solids	mg/L	40
	Total phosphorus	mg/L	3
Effluent Discharge Location	▲ Monaltrie Creek		
Recycled Water Schemes			
Current Reuse	No recycled water used		
Projected Reuse (by 2027)	None planned		
Intended End Use	▲ None		

2.4.2.2 Effluent Quality Data

No water quality data was available for East Lismore WWTP.

3 Regulatory Framework and Approvals

3.1 Overview Relevant Legislation

Recycled water use in NSW is regulated or influenced by several Acts, Regulations and Guidelines, including:

- *Water Management Act 2000* (NSW) (WMA) - not applicable to utilities supplying water under the *Local Government Act 1993* (NSW)
- *Local Government Act 1993* (NSW) (LG Act)
- *Local Government (General) Regulation (2005)*
- *Protection of the Environment Operations Act 1997* (POEO Act)
- *Environment Planning and Assessment Act 1979* (EP&A Act)
- *Environmental Planning and Assessment Regulation 2000 (LG Regulation)*
- *Public Health Act, 2010* (PH Act)
- *Water Industry Competition Act 2006 (NSW)* (WICA) – not applicable to local government regional water utilities
- Australian Guidelines for Water Recycling: Managing Health and Environmental Risk (Phase 1), NRMMC/EPHC/AHMC 2006 (AGWR)
- The Australian Guidelines for Water Recycling: Augmentation of drinking water supplies (Phase 2 (Module 1))
- Environmental Guidelines: Use of Effluent by Irrigation, NSW DEC 2004
- Recycled Water Guidance Document: Recycled Water Management Systems NSW DPI Water (2015)

The POEO Act provides for pollution control and environment protection while the EP&A Act regulates land use, planning and development in NSW. Constituent councils currently hold licences for each of their WWTPs, outlining conditions under which discharges may be made to the environment. Depending on the proposed recycled water scheme options, negotiations with the NSW EPA to extend these licences to allow indirect potable reuse (IPR) discharges may be required. The type and quantity of discharge will be dependent upon the treatment processes, location of these works and discharge options available (e.g. ocean outfall, aquifer recharge etc) . If a new treatment facility is constructed a new licence may be required.

The LG Act, amongst other things, allows councils to construct and operate water, sewerage and stormwater services. Section 60 of the LG Act is the primary provision regulating the operation of council water recycling schemes in NSW. The LG Regulation outlines typical performance standards and criteria for the operation of a recycled water scheme. The specific requirements for scheme performance and compliance will be dictated by the proposed end use, level of public access and any environmental issues or potential health risks associated with the scheme.

Any new infrastructure to be constructed as a result of this investigation would also be subject to local environmental and planning approvals, as dictated by the following legislation:

- State Environmental Planning Policy (Infrastructure) 2007 (SEPP)
  - Part 12A Pipelines and pipeline corridors may apply (depending on activity undertaken)
  - Division 18 Sewage Systems
- Local Environmental Plan (LEP)

Each constituent council has their own development application and approval process and is governed by individual Local Environment Plans (LEPs) and in accordance with the relevant State Environmental Planning Policies. Planning controls should be applied with the following hierarchy:

1. Act
2. Regulation
3. State Environment Planning Policy (SEPP)
4. Local Environment Plan (LEP)
5. Council specific planning requirements (e.g. development application)

3.2 Requirements for Rous County Council

RCC operates under the Local Government Act (1993), as a bulk water supplier and therefore is not regulated by the Water Management Act (2000) or the Water Industry Competition Act (2006). In accordance with the Local Government Act (1993), Rous will require the following approvals to construct and operate any recycled water schemes within the constituent council areas:

- Section 68 approval from each Council
- Section 60 approval from the Minister of Primary Industries

To obtain these approvals, Rous will likely need to complete a development application (DA) for each proposed scheme, depending on the recycled water activity classification and other requirements laid out in each Council's Local Environment Plan (LEP). Depending on the size and end use of the schemes, an Environmental Impact Statement (EIS) may also be required as part of the approval process.

Specific requirements of the approval process for each proposed scheme will be subject to the zoning classification on which an AWRP is proposed and as a result of further development of the proposed design and operation of the schemes.. Liaison with Council, NSW Health and DPIE (Water) will be required.

3.3 Native Title Claim

A native title claim has recently been approved for areas of land and sea within BySC and BSC as shown in Figure 3-1.

The claim is for non-exclusive native title rights and interest in the waters within the determination area. Whilst Emigrant Creek Dam is not within the native title area, the claim includes a portion of Emigrant Creek, ending approximately 2 km north of Emigrant Creek Dam.

Additional consultation should be undertaken for any works that are likely to impact this newly granted right. This would include discharge of treated effluent for IPR into water in this area.

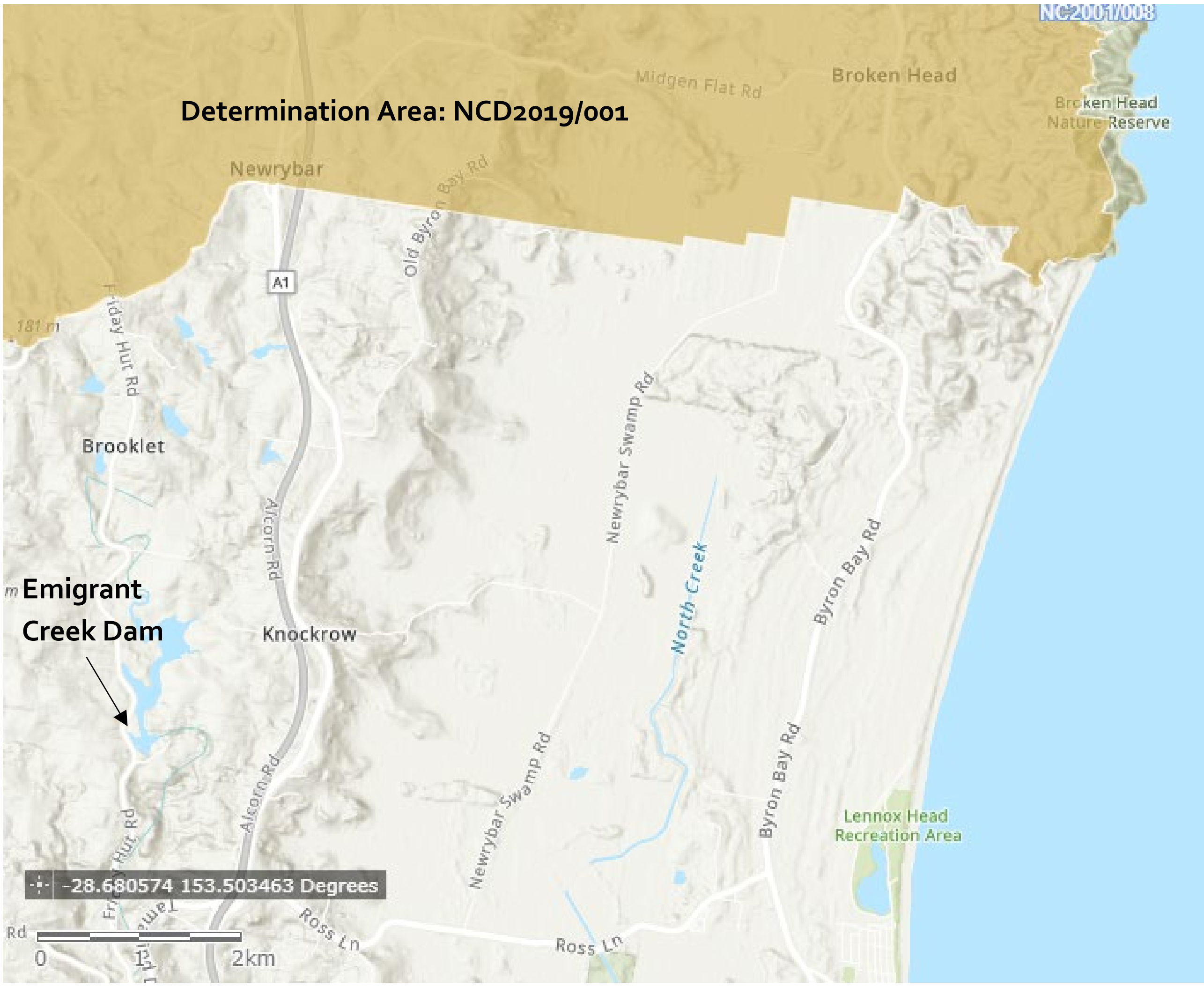


Figure 3-1 Southern Border of Native Title Determination Area

4 Industry Case Studies

Recycled water schemes are becoming increasingly prevalent throughout Australia. They are primarily being used as a drought mitigation strategy as a way of reducing the demand on potable water supplies, or as a way of replenishing raw water sources in drinking water catchments. Indirect potable reuse (IPR) and direct non-potable reuse are the main applications for recycled water, some examples of these are outlined below.

4.1 Western Corridor Recycled Water Scheme, Brisbane

The Western Corridor Recycled Water Scheme is regarded as the largest recycled water scheme in Australia. It has a capacity of 232 ML/d and consists of six sewage treatment plants (STPs) that provide secondary effluent to the three advanced water treatment plants (AWTPs) which further treat the effluent to a suitable quality for IPR. The scheme has been largely mothballed since 2014 due to adequate dam storage volumes.

Table 4-1: Overview of the Western Corridor Scheme

Western Corridor Recycled Water Scheme	
Location	Brisbane, QLD
Capacity	232 ML/d
Utility	Seqwater
Sources of Treated Effluent	6 STPs: ▲ Bundamba ▲ Gibson Island ▲ Goodna ▲ Luggage Point ▲ Oxley Creek ▲ Waco
Effluent Quality	Secondary effluent
Advanced Water Treatment Process	▲ Membrane filtration ▲ Reverse osmosis ▲ Advanced oxidation (UV/H_2O_2) ▲ Chlorination
End Uses	▲ Augmentation of drinking water supply via IPR to Wivenhoe Dam (currently not in operation) ▲ Cooling water for electricity generation

The general treatment process at the STPs include biological treatment, clarification, and disinfection. The process at the AWTPs include chloramination, coagulation and settling as pre-treatment, followed by microfiltration prior to reverse osmosis. The final stages include UV disinfection, stabilisation of the treated water, and chlorination prior to discharge.

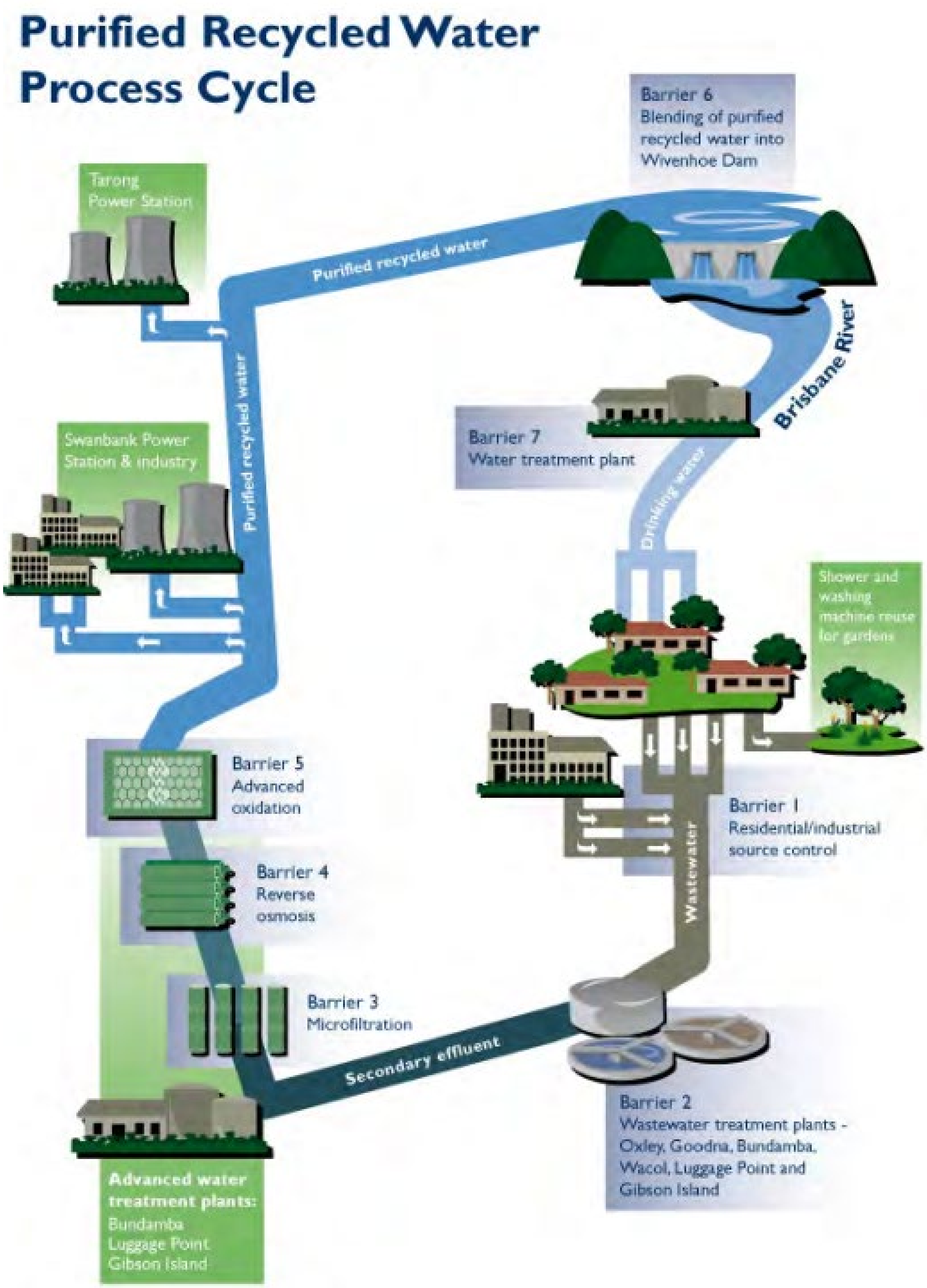


Figure 4-1: Schematic of the Western Corridor Scheme Water Cycle

The highly treated recycled water was intended for use in augmenting the drinking water supply, and for power station cooling water.

4.2 St Mary's Advanced Water Recycling Plant, Sydney

The St Marys Advanced Water Recycling Plant (AWRP) forms a critical part of "The Replacement Flows Project". The plant process approximately 60 ML/d of tertiary effluent from Penrith, St Marys and Quakers Hill water recycling plants .

Table 4-2: Overview of the St Marys Scheme

St Marys Advanced Water Recycling Plant	
Location	Sydney, NSW
Capacity	60 ML/d
Utility	Sydney Water
Sources of Treated Effluent	3 water recycling plants:: ▲ St Marys ▲ Penrith Quakers Hill
Effluent Quality	Tertiary effluent
Advanced Water Treatment Process	▲ Screening ▲ Ultrafiltration ▲ Reverse osmosis ▲ Decarbonation
Energy used	▲ 9673 MWh per 1 ML produced
End Uses	▲ Augmentation of drinking water supply via IPR to Boundary Creek

The tertiary effluent is further treated through membrane filters and reverse osmosis, then decarbonated prior to release into Boundary Creek a tributary of the Hawkesbury-Nepean River.

Figure 4-2: Schematic of the Replacement Flows Scheme Water Cycle

The highly treated effluent produced by the St Marys AWTP replaces 18 GL of fresh water that would otherwise be released from Warragamba Dam each year to maintain required environmental flows.

4.3 Mount Martha Water Recycling Plant, Mornington Peninsula

The Mount Martha Water Recycling Plant obtains effluent from the Mount Martha and Somers STPs for advanced treatment to produce Class A recycled water. The plant produces approximately 26 ML/d of recycled water for IPR and industrial reuse.

Table 4-3: Overview of the Mount Martha Scheme

Mount Martha Water Recycling Plant	
Location	Mornington Peninsula, VIC
Capacity	26 ML/d
Utility	South East Water
Sources of Treated Effluent	▲ Mount Martha STP ▲ Somers STP
Effluent Quality	▲ Secondary effluent (Mount Martha) ▲ Class C effluent (Somers)
Advanced Water Treatment Process	▲ Thermophilic anaerobic digestion process (TPAD) ▲ Ultrafiltration ▲ Pre-chlorination ▲ UV disinfection ▲ Chlorination disinfection
End Uses	▲ Discharge to Boags Rocks via South Eastern Outfall ▲ Class A Reuse (including firefighting) along South Eastern Outfall

Recycled water from Mount Martha joins with Class A effluent from the Eastern Treatment Plant and is released to Boags Rocks via the South Eastern Outfall. Any approved reuse customers along the South Eastern Outfall are able to obtain Class A effluent for reuse purposes including firefighting, farm use, wineries business and council facilities.

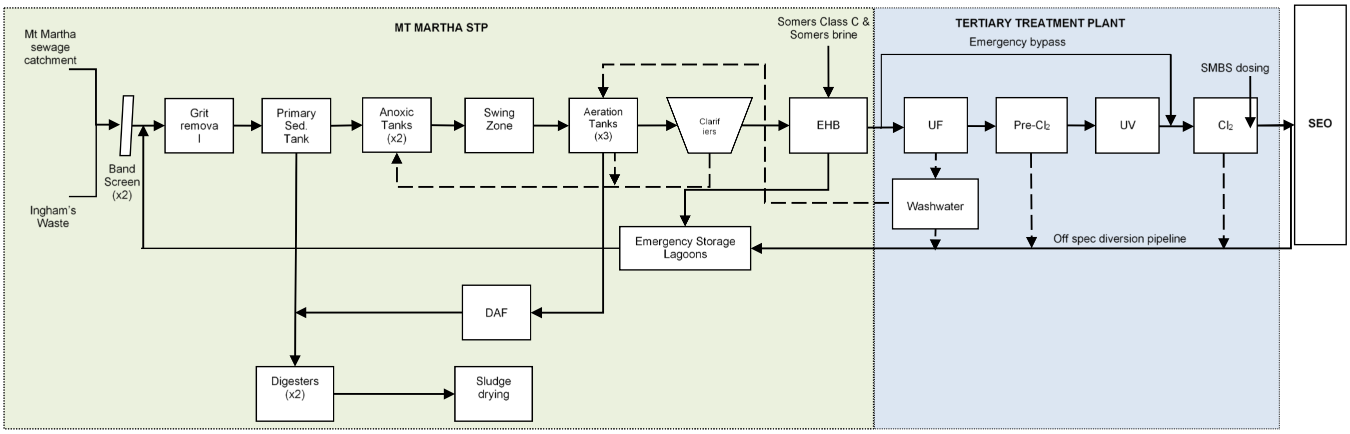


Figure 4-3: Process Flow Diagram for the Secondary and Tertiary Treatment of Effluent at Mount Martha

4.4 Beenyup Advanced Water Recycling Plant, Perth

The Beenyup Advanced Water Recycling Plant was commissioned in June 2016. A demonstration plant operated from 2009 to 2012 for evaluation by regulatory agencies and for community engagement.

Duplication of the plant has been approved and construction is scheduled to start later in 2020. The total capacity will be 28 GL/y which is around 10% of Perth's average annual demand. The process is illustrated in the figure below.

Table 4-4: Overview of the Beenyup Scheme

Beenyup Advanced Water Recycling Plant	
Location	Beenyup, WA
Capacity	14 GL/y
Utility	Water Corporation WA
Sources of Treated Effluent	Beenyup WWTP
Effluent Quality	▲ Secondary effluent
Treatment Process	▲ Ultrafiltration ▲ Two stage reverse osmosis ▲ UV Disinfection
End Uses	▲ Injection into Leederville aquifer for IPR via groundwater recharge

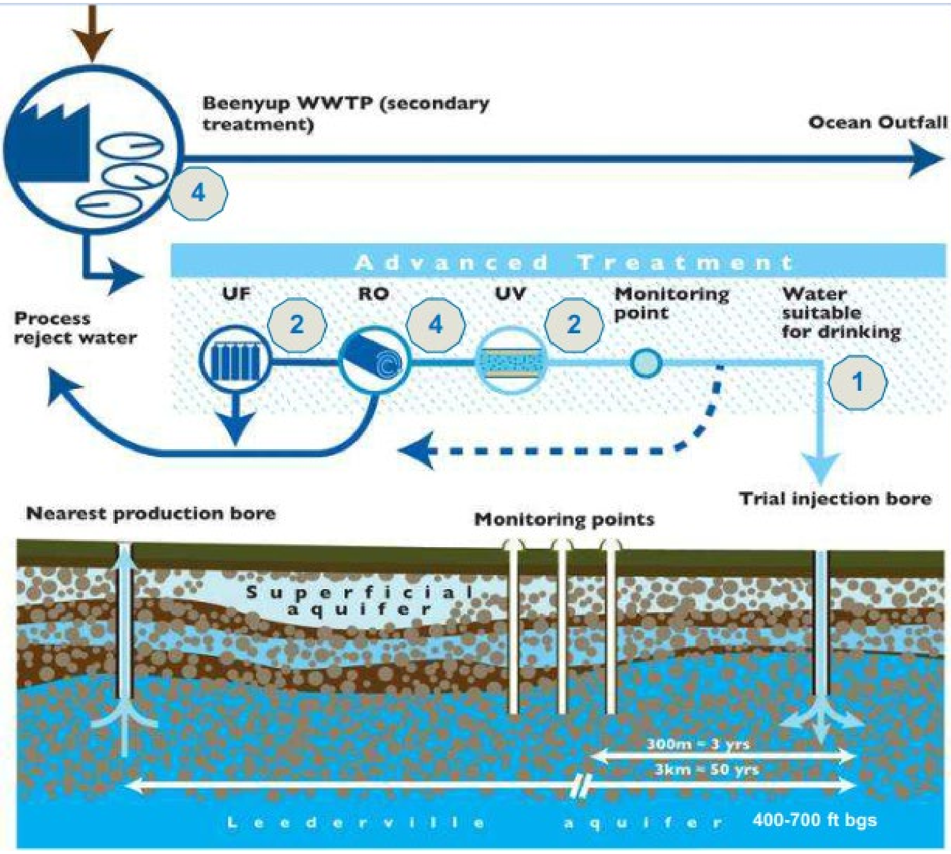


Figure 4-4 Process Illustration for AWRP for Beenyup AWRP Diagram from Lozier, J "Beenyup Advanced Water Recycling Plant" presented at the Water Reuse in Texas Conference March 2019 (Water Environment Association of Texas)

4.5 Beaufort West, South Africa

Beaufort West is a city of some 50,000 people near the Karoo National Park approximately 460 km north east of Cape Town in South Africa. Located in desert, Beaufort West's water supply has traditionally come from three dams: Gamka, Springfontein and Walker and supplemented by groundwater from 36 bores.

Due to ongoing challenges to maintain water security, the Council of the Municipality of Beaufort West commissioned a potable water recycling facility in 2011.

Table 4-5: Overview of the Beaufort West Scheme

Beaufort West	
Location	Beaufort West, Western Cape Province, South Africa
Capacity	1 ML/d
Utility	Council of the Municipality of Beaufort West
Treatment Process	▲ Ultra-filtration ▲ Reverse Osmosis ▲ UV ▲ Advanced oxidation (H_2O_2/UV) ▲ Chlorination
End Uses	▲ Drinking water for Beaufort West

The facility supplies approximately 20% of the city's water through advanced treatment of recycled water from their conventional tertiary wastewater treatment plant.

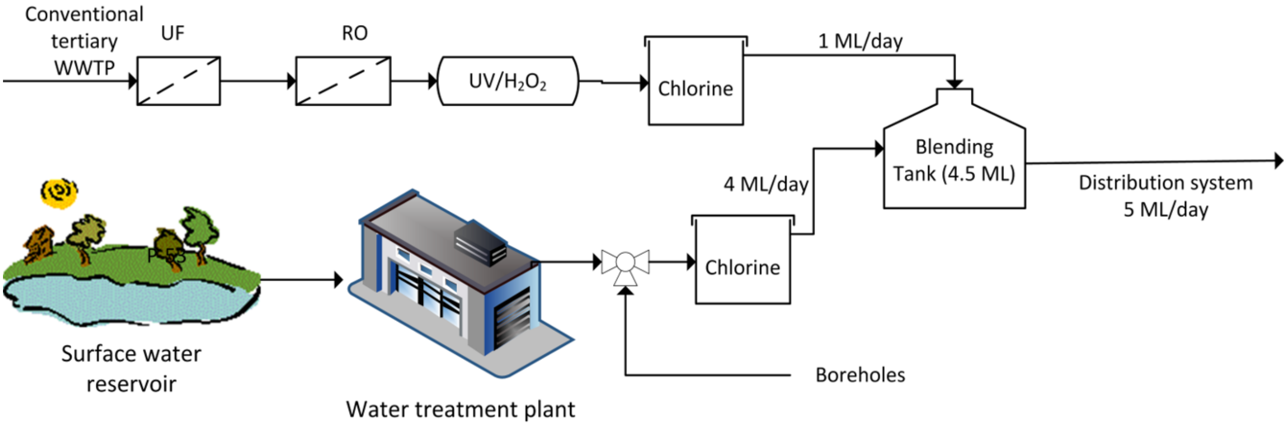


Figure 4-5 *'Sustainable Water Supply into the Future for Regional Communities – the need for a More Collaborative and Bold Path Forward'* Diagram courtesy of Ian Law. Presented at the AWA NSW Regional Conference, Orange, NSW, October 2019. Used with permission

5 Water Saving Opportunities

5.1 Overview of Opportunities

▲

RCC is a county council specifically set up to provide some key functions to its constituent councils, one of which is provision of bulk supply of potable water. There are over a dozen wastewater treatment plants within the county area. Based on high level analysis in Chapter 2, six have been identified as having potential to provide recycled water for potable demand reduction. These plants are:

- Ballina WWTP,
- Lennox Head WWTP,
- Alstonville WWTP,
- Bangalow WWTP,
- South Lismore WWTP, and
- East Lismore WWTP.

These plants are operated by constituent council members of Rous County Council. An analysis of water saving opportunities at each plant is outlined below, based on up to date plant flow data and outcomes from RCC's Future Water Strategy (IWCM) dated June 2014.

Generally, as expected by the RCC Future Water Strategy report, sewage flows are increasing overall as shown in Figure 5-1 below. Hence, the yield from the WWTPs is expected to continue to increase.

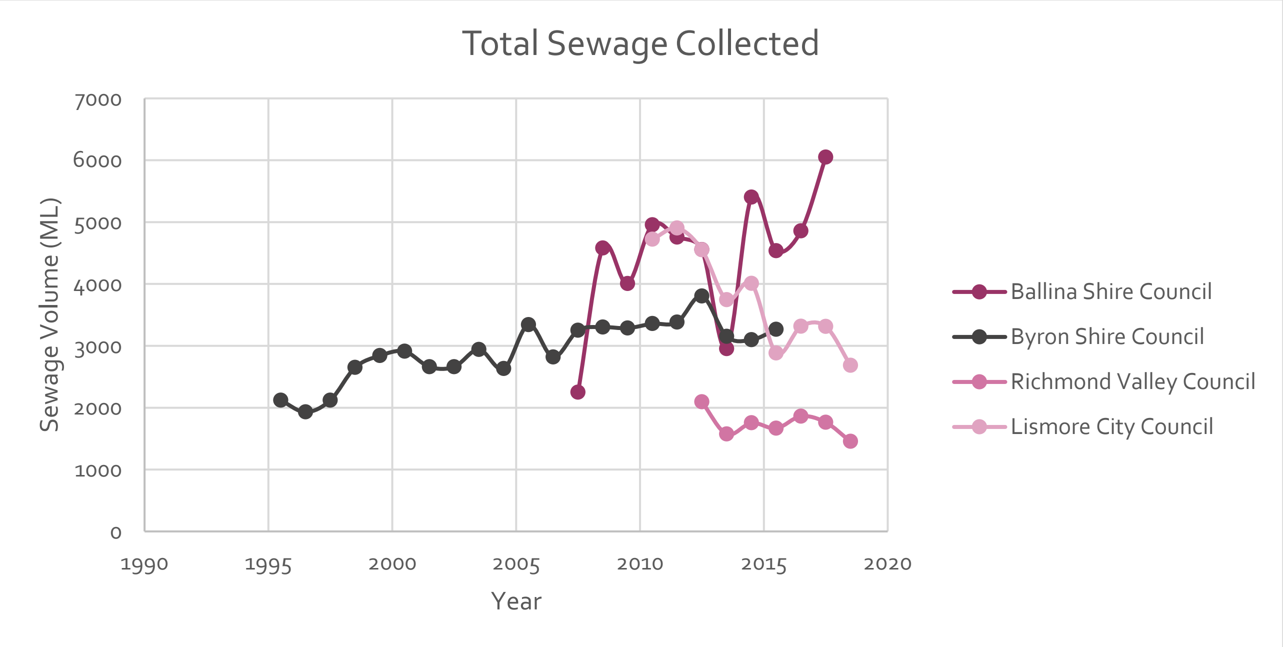


Figure 5-1 Total Sewage Collected by Council

For the purposes of consistency, it should be noted that environmental flows to any river, estuarine or ocean systems have not been classified as recycled or reused. These flows have been analysed as discharge to the environment. Any future environment flow requirements related to the controlled release of treated effluent is likely to reduce the available water yields indicated below.

5.1.1 Ballina WWTP

Ballina WWTP is operated by Ballina Shire Council (BSC) and is located on Fishery Creek Road in West Ballina. Data provided by BSC, as summarised in Figure 5-2 below, indicates that in recent years the WWTP has processed annual volumes of approximately 2,400-3,400 ML. Most of this water is discharged to the ocean, with only a small proportion being recycled. It appears that no effluent from this plant has been recycled in recent years. Recycled water schemes in greater Ballina appear to be supplied from the Lennox Head WWTP.

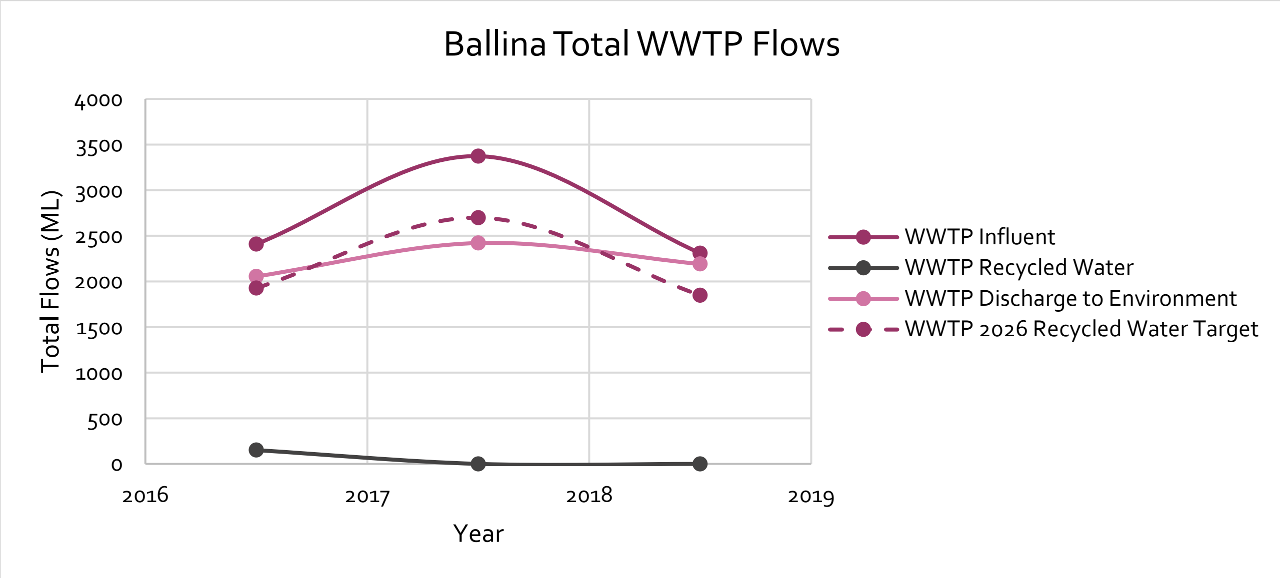


Figure 5-2 Analysis of Total Influent and Effluent at Ballina WWTP

BSC, as part of their Recycled Water Masterplan, has a target to reuse 80% of dry weather treated wastewater flows at the Ballina WWTP by 2026. BSC's current recycled water system in the Ballina area includes both dual reticulation and open space irrigation. Council has major plans to expand the scheme with additional infrastructure and expanded supply zones for dual reticulation, open space irrigation and vegetation regeneration activities.

RCC, in their IWCM process, has previously undertaken an investigation of the suitability of indirect potable reuse of effluent at the Ballina WWTP. The study assessed dry weather flows to the treatment plant and accounted for anticipated recycled water demands in the area, though it is unclear what reuse scenario was considered. The investigation considered Ballina WWTP together with Lennox Head WWTP and suggested that combined they currently had the potential to provide 1,300 ML/A of additional yield. Between the two plants, this would appear to be achievable in the short term based on the volumes and relative seasonal constancy of flows at present, noting seasonal consistency of effluent flows is slightly unclear due to missing data.

Based on the available effluent and minimal discharges to the ocean, there is significant opportunity for additional water reuse or indirect potable reuse. However, despite BSC appearing to be currently well short of achieving 80% recycling of dry weather flow, this opportunity needs to be considered in light of BSC's plans to expand their existing recycled water scheme and the associated availability of water into the future.

5.1.2 Lennox Head WWTP

Lennox Head WWTP is operated by BSC and is located on North Creek Road, Lennox Head. Data provided by RCC, as summarised in Figure 5-3 below, indicates that the treatment plant in recent years has processed annual volumes of approximately 1,400-1,700 ML. While much of this water is discharged to the ocean, the discharge volumes are decreasing, with a growing proportion being recycled and provided to customers on BSC's local recycled water network.

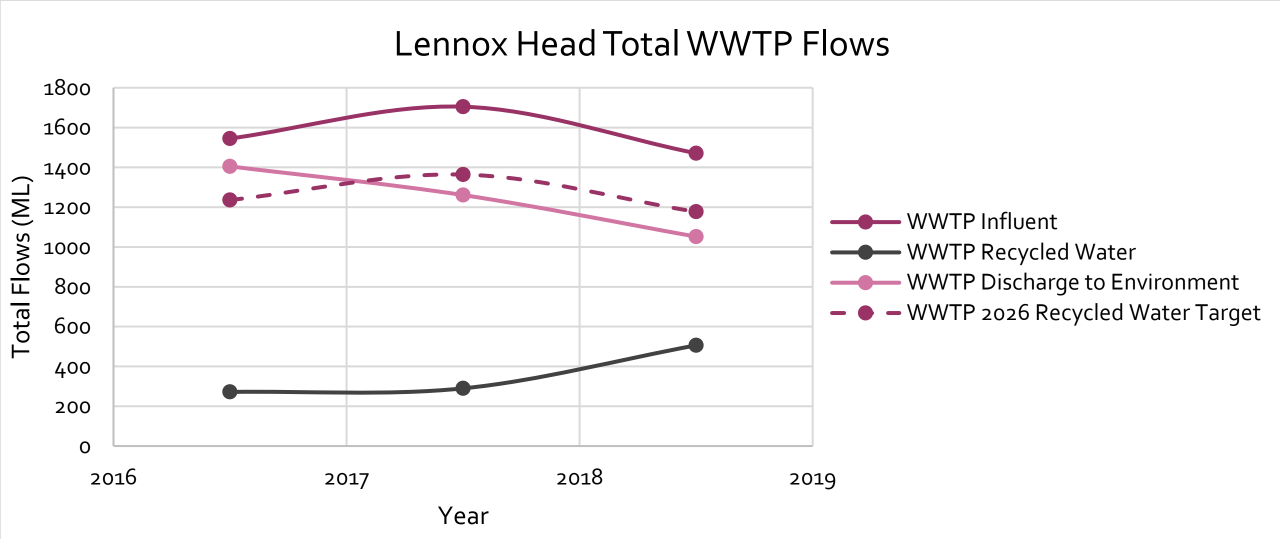


Figure 5-3 Analysis of Total Influent and Effluent at Lennox Head WWTP

Similarly to Ballina WWTP in the previous section, BSC has a target to reuse 80% of dry weather effluent at the Lennox Head WWTP by 2026. Monthly reuse data, summarised in Figure 5-4 below, indicates that at present there is good availability of water across the year, though decreasing due to the increasing use of recycled water. The reasons for the high peaks in 2011 and 2016 are uncertain.

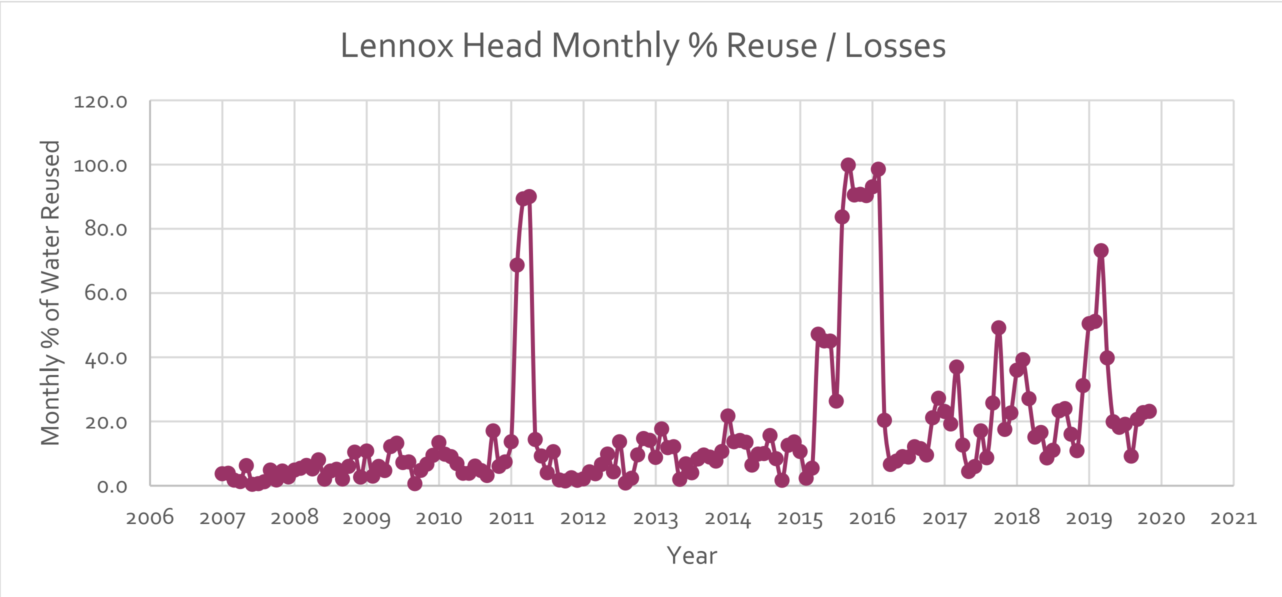


Figure 5-4 Analysis of Reuse / Losses at Lennox Head WWTP

As discussed above for Ballina WWTP, based on previous investigations there is significant opportunity for additional water reuse or indirect potable reuse. However, this opportunity should be considered in light of

BSC's plans to expand their existing recycled water scheme. Further considerations are outlined in Section 5.2 and Section 6.

5.1.3 Alstonville WWTP

Alstonville WWTP is operated by BSC and is located on Johnstons Road, Alstonville. Data provided by RCC, as summarised in Figure 5-5 below, indicates that the WWTP has processed annual volumes of approximately 600-750 ML in recent years. In the 2018-2019 year, the Alstonville plant recycled approximately 50% of the plant's effluent.

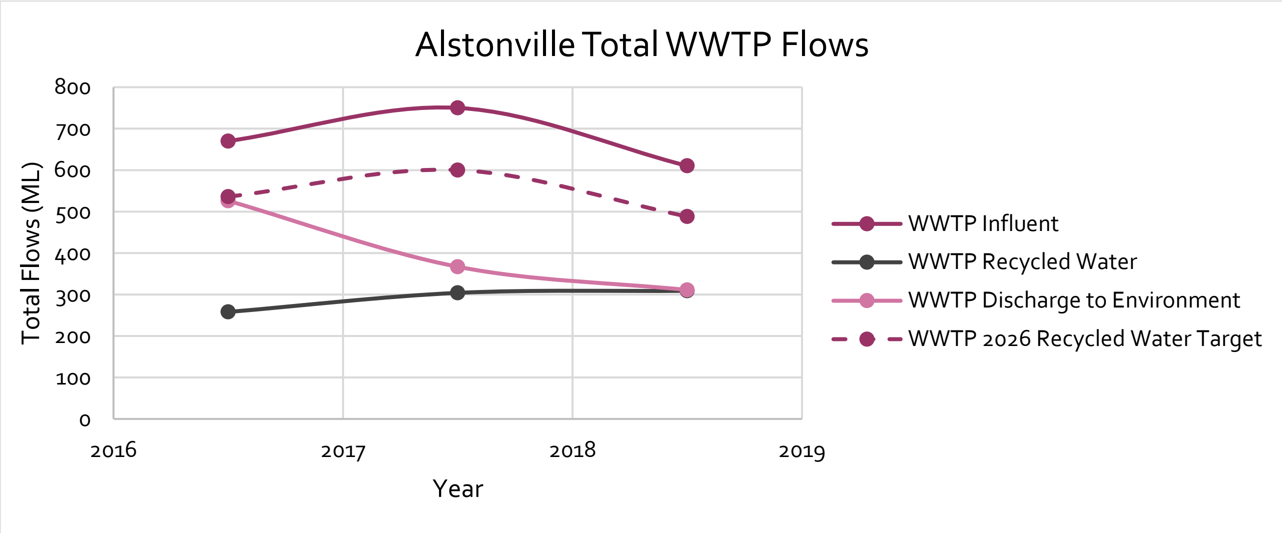


Figure 5-5 Analysis of Total Influent and Effluent at Alstonville WWTP

BSC previously has targeted to reuse 80-100% of dry weather flows within the local recycled water network. BSC's current recycled water system in the Alstonville area mainly involves irrigation to council reserves, farms and nurseries. Monthly reuse data, summarised in Figure 5-6 below, indicates that recycled water use peaks at around 70-90% in the dry weather period and reaches a minimum at around 20-40% in the wet weather periods.

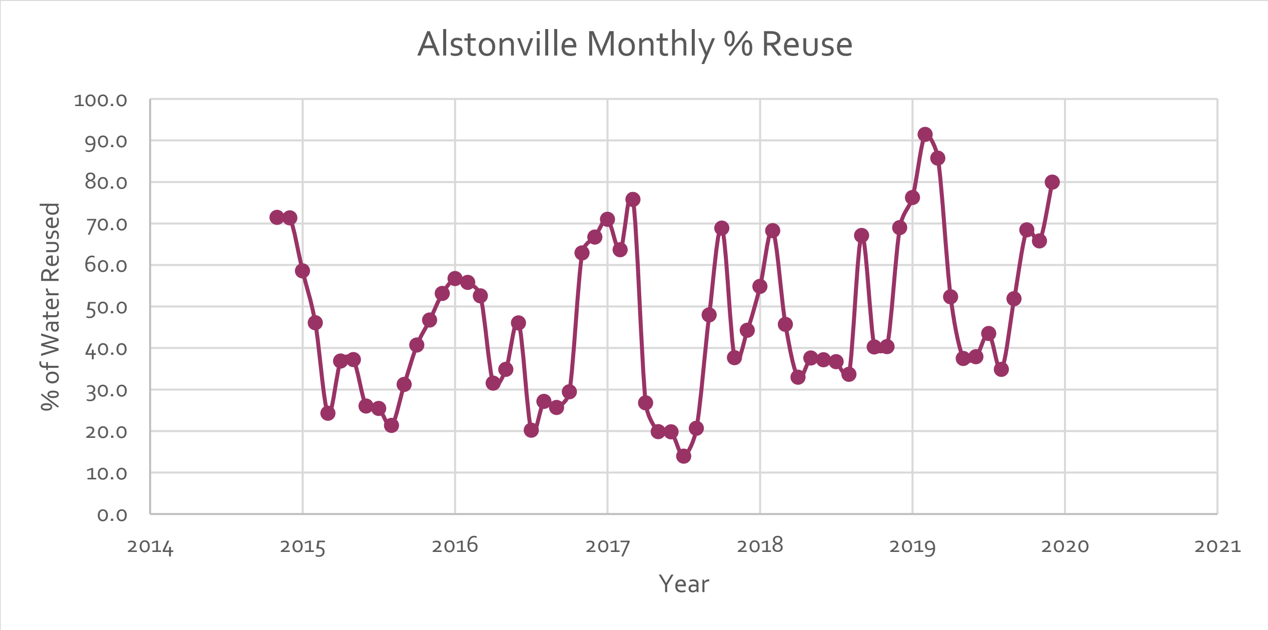


Figure 5-6 Analysis of Reuse at Alstonville WWTP

During the IWCM planning process, RCC undertook an investigation into the suitability of indirect potable reuse of effluent at the Alstonville WWTP. The study assessed dry weather flows to the treatment plant and accounted for anticipated recycled water demands in the area. The investigation suggested that the plant currently had the potential to provide 700 ML of additional yield. Based on the plant flows and high existing water reuse, especially in the dry season, this will not be able to be achieved in the short term.

Considering the available effluent, growing local effluent recycling within the Alstonville area, seasonal constraints (lower reuse demand in wet seasons) and large transfer distances to Emigrant Creek Dam, incorporating Alstonville WWTP into an IPR scheme is not considered to be viable. Further considerations are outlined in Section 5.2 and Section 6.

5.1.4 Bangalow WWTP

Bangalow WWTP is operated by Byron Shire Council and is located on Dudgeons Lane, Bangalow. Data provided by RCC, as summarised in Figure 5-7 below, indicates that the WWTP has processed annual volumes of approximately 140-170 ML in recent years. In the 2016-2019 period, the Bangalow WWTP recycled none of the effluent produced from the plant.

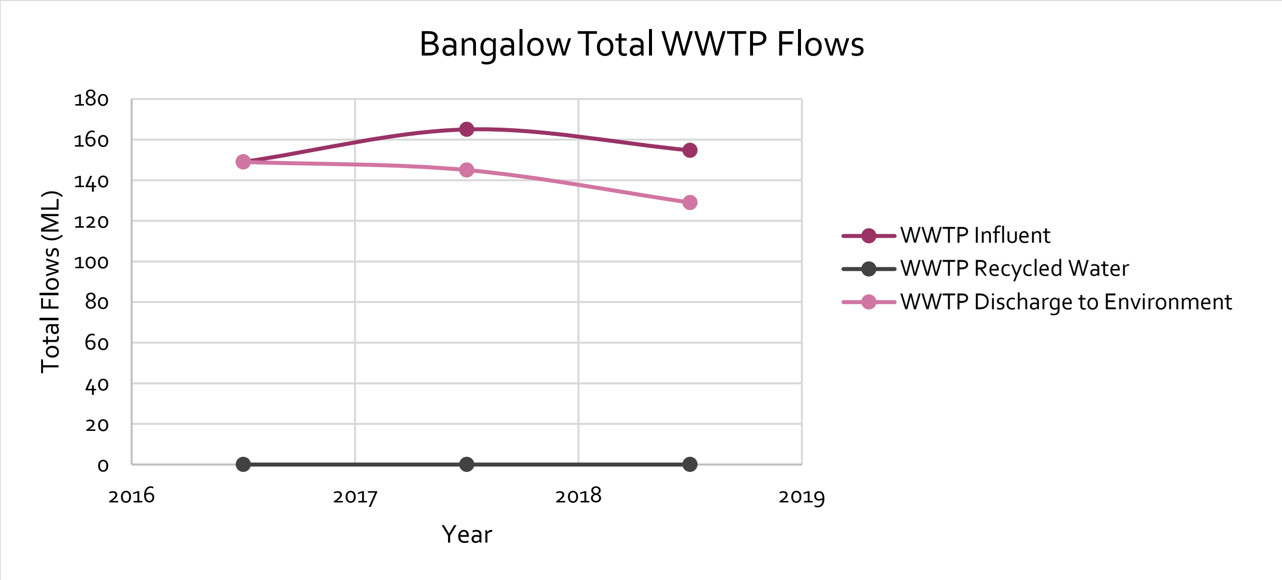


Figure 5-7 Analysis of Total Influent and Effluent at Bangalow WWTP

In the past, 13% recycling of effluent from Bangalow WWTP has been undertaken to irrigate a bamboo crop. It is understood BySC is considering biomass cropping with the intent to achieve 100% reuse of effluent. However, it appears that no major progress has been made in implementing this system. This WWTP was not considered by RCC in their IWCM planning process for indirect potable reuse.

Considering the small volumes of available effluent, BySC's plans to utilise effluent for other purposes and large transfer distances to Emigrant Creek Dam, incorporating Bangalow WWTP into an IPR scheme is not considered to be viable. Any new schemes would have to be considered in conjunction with the BySC to determine further water availability. Further considerations are outlined in Section 5.2 and Section 6.

5.1.5 South Lismore WWTP

South Lismore WWTP is operated by Lismore City Council (LCC) and is located on Three Chain Road, South Lismore. Data provided by RCC, as summarised in Figure 5-3 below, indicates that the treatment plant in recent years has processed annual volumes of approximately 1,000-1,900 ML. LCC discharge the vast majority of the plant effluent into a local creek with an insignificant amount being recycled.

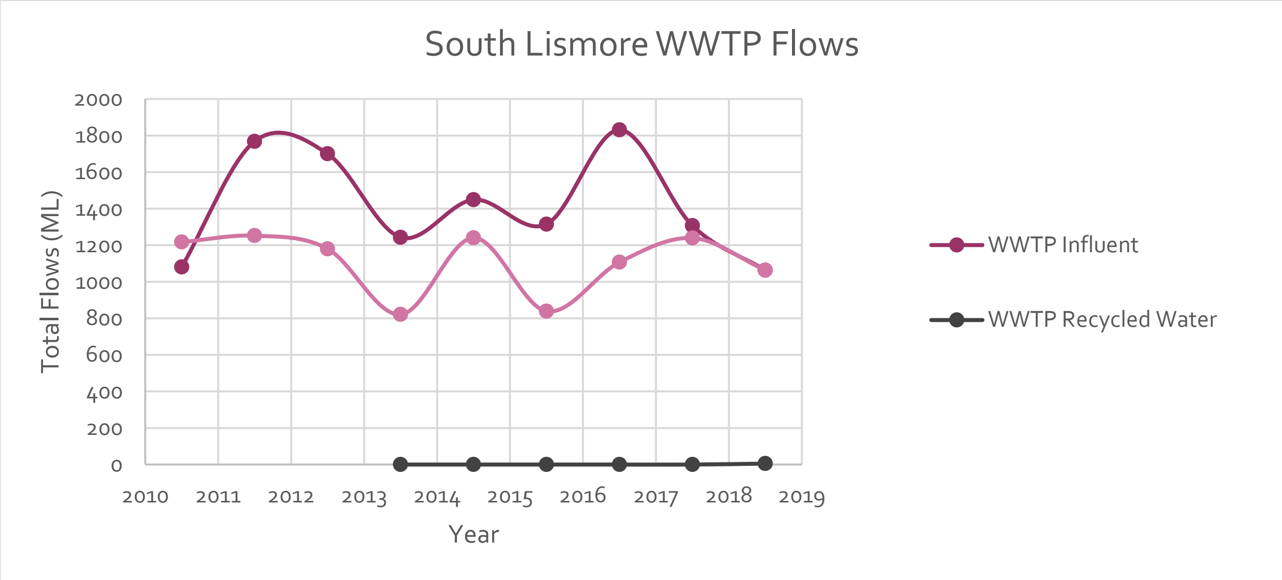


Figure 5-8 Analysis of Total Influent and Effluent at South Lismore WWTP

RCC has previously undertaken an investigation of the suitability of indirect potable reuse of effluent at the East and South Lismore plants in their IWCM planning process. The study assessed dry weather flows to the treatment plant and accounted for anticipated recycled water demands in the area. The investigation considered the South Lismore WWTP together with East Lismore WWTP and suggested that combined they currently had the potential to provide 2,700 ML of additional yield.

Based on the above previous study and LCC data indicating moderate flows with minimal current reuse, there is a significant opportunity for recycled effluent or indirect potable reuse of effluent from the South Lismore WWTP. Further considerations are outlined in Section 5.2 and Section 6.

5.1.6 East Lismore WWTP

East Lismore WWTP is operated by LCC and is located on Wyrallah Road, East Lismore. Data provided by RCC, as summarised in Figure 5-9 below, indicates that the treatment plant in recent years has processed annual volumes of approximately 1,300-3,500 ML. In 2016/2017, there is a small anomaly in the data where the measured influent to the plant is less than the plant effluent. LCC discharge much of the plant effluent into a local creek with an insignificant amount being recycled.

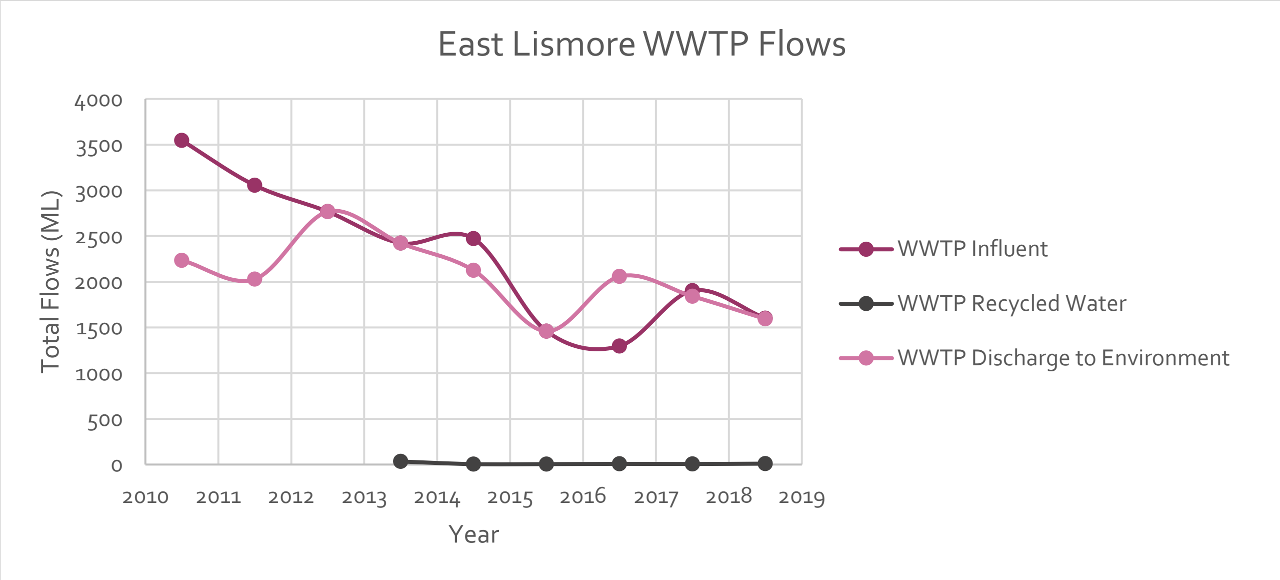


Figure 5-9 Analysis of Total Influent and Effluent at East Lismore WWTP

As mentioned above, previous IWCM investigations considering South Lismore WWTP together with East Lismore WWTP suggested that combined they currently had the potential to provide 2,700 ML of additional yield.

Based on the above previous study and LCC data indicating moderate flows with minimal current reuse, there is opportunity for recycled effluent or indirect potable reuse of effluent from the East Lismore WWTP. Further considerations are outlined in Section 5.2 and Section 6.

5.2 Potential Potable Water Savings

Based on the water saving opportunities outlined above, potential potable water savings are summarised below. Indirect potable reuse has advantages over non-potable reuse because it is distributed through the existing potable water supply network. It can always be available as a base load to the supply system and directly offsets existing water sources, reducing draw-down of water storages and improving water security. Lastly, unlike non-potable schemes, consumers pay full price. Often dual reticulation schemes or open space irrigation schemes, while they partially result in potable water offsets, often generate additional water usage which cannot be claimed as a potable water offset.

Also, because the indirect potable reuse schemes tend to utilise existing infrastructure, costs are minimised as existing water treatment plants are utilised and no further distribution systems such as dual reticulation systems are required. The main costs for an indirect potable reuse (IPR) scheme generally are driven by drinking water quality treatment requirements, costs to convey the treated effluent back to source water locations and treating it again in the water treatment plants. It should be noted that direct potable reuse, if it were acceptable, would reduce the overall capital and operating cost by eliminating bulk water transfer infrastructure and double treatment.

5.2.1 Ballina WWTP and Lennox Head WWTP

Ballina WWTP and Lennox Head WWTP have good potential for potable water savings, with current combined annual average effluent flow of above 3,500 ML/a. We consider that a conservative combined dry weather flow of 6 ML/d from the two WWTPs based on low flows in recent years reduces the total available to 2,200 ML/a. Thus, a range of 2,200 – 3,500 ML/a will likely be available subject to seasonal variations.

In analysing the data provided by RCC the following assumptions have been made:

- 75% source water recovery has been assumed for each reuse scenario.
- BSC has an 80% target for recycled water reuse by 2026.
  - Option 1: BSC achieve 70% recycled water reuse by 2026, with the remaining effluent assumed to be available for IPR.
  - Option 2: BSC achieve 40% recycled water reuse by 2026, with the remaining effluent assumed to be available for IPR.
- The average dry weather flow has been derived from total annual flow data from both plants. Two scenarios have been assumed:
  - Conservative scenario: combined average dry weather flow for both plants (6 ML/day) based on 60% of the daily average of worst case total annual flow over the three years of provided data (2016-2019).
  - Less conservative scenario: combined average dry weather flow for both plants (9 ML/day) based on 90% of the daily average of worst case total annual flow over the three years of provided data (2016-2019).

The table below shows the annual potable water savings based on different recycled water usage by BSC by 2026 and different ADWF scenarios.

Table 5-1 Annual Potable Water Savings Estimates for Ballina and Lennox head WWTPs

	ADWF (ML/d)	Annual potable water savings (ML)
Option 1: **70 % reuse of recycled water by BSC**	6	500
	9	740
Option 2: **40 % reuse of recycled water by BSC**	6	975
	9	1450

It is unclear why savings identified above are generally different to what is expected in the RCC IWCM report (1,300 ML/a). However, it is likely the IWCM report assumed a different reuse from BSC's recycled water scheme, different dry weather flow or different treatment recovery rates. In the longer term, the volume of savings is also unclear as it largely depends on the amount of reuse achieved by BSC, as well as other factors such as population, weather and climate change.

The amount of potential potable water savings associated with increased up take of recycled water from Ballina and Lennox Head WWTP is highly dependent on non-potable recycled water usage through BSC's existing recycled water scheme. Any potable water saving scheme in addition to the existing and future council recycled water schemes needs further consultation and agreement with Council, as well as more detailed planning prior to proceeding.

5.2.2 Alstonville WWTP

Alstonville WWTP has a low potential for potable water savings due to moderately low flows and significant existing water recycling in the area. The plant produces current annual effluent flows generally over 600 ML and daily flows of typically above 1 ML/day. Based on an assumed conservative daily flow (from recent low flows) of 1 ML from the plant, the WWTP currently has the potential to provide around 360 ML annually of consistent treated effluent flows. A less conservative dry weather flow of 1.5 ML/day from the WWTPs based on 90% of average recent influent flows results in the potential to provide around 540 ML annually of treated effluent flows. Flows will likely be between these two values, but this will be subject to seasonal variations.

In analysing the data provided by council the following assumptions have been made:

- 75% source water recovery has been assumed for each reuse scenario.
- The average dry weather flow has been derived from total annual flow data from the plant.
  - Conservative scenario: combined average dry weather flow for the plant (1 ML/day) based on 60% of the daily average of worst case total annual flow over the three years of provided data (2016-2019).

Less conservative scenario: combined average dry weather flow for the plant (1.5 ML/day) based on 90% of the daily average of worst case total annual flow over the three years of provided data (2016-2019).Approximately 300 ML of this available water was utilised in the 2018-2019 year for recycled water which is achieving council's target of 80% reuse of dry weather flows based on dry weather flow of 1 ML/day. Assuming a dry weather flow of 1 ML/day and assuming the remaining 20% of dry weather flows can be utilised as potential potable water savings, approximately 50 ML annually of potable water could be saved across the year if used as a potable offset. Assuming a higher dry weather flow of 1.5 ML/day, based on only being able to utilise 20% of dry weather flows, then approximately 80 ML annually of consistent potable water could be saved. Based on these low yield figures IPR is not considered to be a viable option for this treatment plant.

It is unclear why savings are lower than what is expected in the RCC IWCM report (700 ML/a), but it is likely that either the report assumed a lower reuse from BSC's recycled water scheme, a higher dry weather flow was adopted or a different treatment recovery rate was assumed. Noting that the WWTP's current total effluent flows are 600-750 ML/a and 300 ML/a reuse is currently being achieved, the plant will not achieve the yields specified in the RCC IWCM report.

5.2.3 Bangalow WWTP

Bangalow WWTP has a low potential for potable water savings with current annual effluent flows generally over 120 ML and daily flows typically above 0.2 ML/day. Based on an assumed daily flow of 0.2 ML (from recent low flows) from the plant, the WWTP currently has the potential to provide around 70 ML annually of consistent treated effluent flows across the year. A less conservative dry weather flow of 0.35 ML from the WWTPs based on 90% of average recent influent flows results in the potential to provide around 110 ML annually of treated effluent flows. Flows will likely be around these two values, but this will be subject to seasonal variations.

In analysing the data provided by council the following assumptions have been made:

- 75% source water recovery has been assumed for each reuse scenario.
- The average dry weather flow has been derived from total annual flow data from the plant.

- Conservative scenario: combined average dry weather flow for the plant (0.2 ML/day) based on 60% of the daily average of worst case total annual flow over the three years of provided data (2016-2019).
- Less conservative scenario: combined average dry weather flow for the plant (0.35 ML/day) based on 90% of the daily average of worst case total annual flow over the three years of provided data (2016-2019).

No water recycling of plant effluent is currently being undertaken, but it is understood BySC has plans to fully utilise the effluent from the plant for biomass cropping. Bangalow WWTP was not considered in RCC's IWCM report as having potential for indirect potable reuse, likely due to the plant's low flows and existing water recycling scheme. Due to the plant's significantly low flows, IPR is not considered viable in this case. Additionally, any potable water saving scheme will need further consultation and agreement with the BySC, as well as more detailed planning, due to BySC's existing plans to heavily utilise the effluent from the plant in future.

5.2.4 South Lismore WWTP and East Lismore WWTP

South Lismore WWTP and East Lismore WWTP have good potential for potable water savings, with current combined annual average effluent flow of above 2,600 ML/a. We consider that a conservative combined dry weather flow of 4.4 ML/d from the two WWTPs based on low flows in recent years reduces the total available to 1,600 ML/a. A less conservative dry weather flow of 6.5 ML/day from the WWTPs based on 90% of average recent influent flows results in the potential to provide around 2,400 ML annually of treated effluent flows. Flows will likely be between these two values, but this will be subject to seasonal variations.

In analysing the data provided by council the following assumptions have been made:

- 75% source water recovery has been assumed for each reuse scenario.
- LCC has no known recycled water targets and undertake very little water recycling. Hence the following assumptions have been made:
  - Scenario 1: LCC achieve 20% recycled water reuse by 2026, with the remaining effluent assumed to be available for IPR.
  - Scenario 2: LCC achieve 0% recycled water reuse by 2026, with the remaining effluent assumed to be available for IPR.
- The average dry weather flow has been derived from total annual flow data from both plants. Two scenarios have been assumed:
  - Conservative scenario: combined average dry weather flow for both plants (4.4 ML/day) based on 60% of the daily average of worst case total annual flow over the three years of provided data (2010-2019).
  - Less conservative scenario: combined average dry weather flow for both plants (6.5 ML/day) based on 90% of the daily average of worst case total annual flow over the three years of provided data (2010-2019).

5.2.4.1 Assuming LCC achieve 20% Recycled Water

Approximately 15.2 ML of available water was recycled in the 2018-2019 year. If 20% reuse was achieved, assuming a dry weather flow of 4.4 ML/day, based on the remaining 80% of dry weather flows approximately 960 ML annually of consistent potable water flows could be saved. Assuming a higher dry weather flow of 6.5 ML/day, based on only being able to utilise 80% of dry weather flows, approximately 1425 ML annually of consistent potable water flows would be saved. However, greater savings could be achievable in the shorter term.

5.2.4.2 Assuming LCC achieve No Recycled Water

If LCC continue at very low levels of reuse, assuming a dry weather flow of 4.4 ML/day, based on all dry weather flows approximately 1200 ML annually of consistent potable water flows could be saved. Assuming a higher dry weather flow of 6.5 ML/day, based on being able to utilise all of dry weather flows, approximately 1800 ML annually of consistent potable water flows would be saved. However, greater savings could be achievable in the shorter term.

The expected savings are generally at the same level or potentially higher than what is expected in the RCC IWCM report (1,300 ML/a). However, it is likely the IWCM report assumed a different reuse from BSC's recycled water scheme, a different dry weather flow and different treatment recovery rates. In the longer term, the volume of savings is also unclear as it largely depends on the amount of reuse achieved by LCC, as well as other factors such as population, weather and climate change.

Any potable water saving scheme in addition to the existing and future council recycled water schemes needs further consultation and agreement with Council, as well as more detailed planning prior to proceeding.

5.3 WWTP Process Constraints

5.3.1 Indirect Potable Reuse

The *Australian Guidelines for Water Recycling: Augmentation of Drinking Water Supplies (Phase 2 (Module 1))* (AGWR Phase 2) outlines a risk-based approach to identify significant risks and develop suitable preventive measures and risk management priorities for the use of effluent for indirect potable reuse. A key feature of drinking water augmentation is that the level of exposure of end users is much higher than for other uses of recycled water. The AGWR Phase 2 has used the same basis as the Australian Drinking Water Guidelines (ADWG), in which users consume 2 L per person per day.

For indirect potable reuse, environmental buffers, including both surface water and aquifers can act as a significant control measure. In general they provide:

- Additional time (weeks to years)
- Additional treatment through natural processes
- Dilution – provided that contaminant levels in receiving waters are lower than those in the recycled water.

Water produced for indirect potable reuse should match or exceed the acceptable characteristics of drinking water. Unacceptable appearance, taste or odour in a drinking-water supply augmented with potable reuse can exacerbate consumer unease associated with its origin.

As sewage contains contaminants at levels greater than those commonly found in rivers or reservoirs, higher levels of treatment are needed. Highly reliable barriers are required for both microbial and chemical hazards, and multiple barriers are essential as no single barrier is effective against all hazards and effective all of the time.

Where chemicals are listed in the ADWG, the same values have been applied in the AGWR Phase 2. Where chemicals are not dealt with in the ADWG, an approach for determining guidelines has been developed. A summary of guideline values can be seen in Table 4.4 of the AGWR Phase 2. The guideline value represents the minimum requirement and boundary for defining safety. The highest practicable water quality should be maintained from treatment facilities.

The ADWG also describes an approach to determine a log reduction target for microbial hazards. It uses the following reference pathogens:

- *Cryptosporidium* for protozoa and helminths;
- a rotavirus and adenovirus combination for enteric viruses;
- *Campylobacter* for bacteria;

Based on these reference pathogens and typical concentrations in raw sewage, the log reductions required to achieve compliance with 10^{-6} DALY per person per year are:

- Protozoa: 8 log
- Virus: 9.5 log
- Bacteria: 8.1 log

The AGWR Phase 2 describes and supports a broad range of recycling options, without outlining a specific process that is required. However, indirect augmentation of a drinking water supply generally requires a high-level of advanced treatment, as evident by the log reductions required. An indicative multi-barrier approach that achieves log reduction targets and likely comply with guideline values may include:

- Treatment at a WWTP including:
  - Primary Treatment – physical treatment process
  - Secondary Treatment – biological treatment that removes dissolved and suspended organic material
  - Tertiary Treatment – often filtration (membrane or media), combined with coagulation
  - Disinfection – usually chlorine or UV
- Membrane filtration (Ultrafiltration or Microfiltration)
  - produces high quality water which will protect and achieve more efficient operation of downstream unit processes.
- Reverse osmosis
  - removes remaining dissolved contaminants using a partially permeable membrane
  - single or multi-stage (to increase recovery) and single or double pass (to reduce pathogens) configurations should be considered.
- Advanced oxidation
  - Combines two or more oxidising agents to create hydroxyl radicals to eliminate organic contaminants. Almost all combinations include UV and then combined another chemical , often hydrogen peroxide or ozone..

When selecting treatment options, consideration should be given to the waste streams generated (such as reverse osmosis concentrate) and how they will be handled. This can present a significant hurdle for many advanced wastewater treatment plants.

5.3.1.1 Hydraulic Detention and Dilution

The AGWR Phase 2 does not provide specific guidance on the required hydraulic detention, however augmentation schemes should be designed so that the time in receiving waters is sufficient to enable operators and regulators to assess recycled water treatment and recycled water quality and, where necessary, to intervene before water is supplied to consumers. US EPA Guidelines for Water Reuse recommend setback for a minimum of 2 months retention. Worldwide detention times and dilution rates vary, the AGWR Phase 2 guidelines provide examples where recycled water can comprise of 1 % up to 80-90% depending on climatic conditions.

The minimum detention time should include, with sufficient safety margin, time to:

- Detect a fault - through operational monitoring; and
- Complete corrective actions – before addition to drinking water supplies and delivery to consumers

The system design should also take into consideration possible short circuiting of water. Hydrological characteristics specific to each water source will determine the preferred flow paths for water and discharge into these flow paths should be minimised.

For surface water systems, detention rates can also vary significantly based on temperature and rainfall both of which influence the reservoir level and its evaporation, as well as its other inflows.

The effective volume of current RCC water sources:

- Emigrant Creek Dam (ECD): 750 ML
  - Emigrant Creek WTP 7.5 ML/d WTP
- Rocky Creek Dam (RCD): 1400 ML
  - NightCap WTP 70 ML/d
- Wilson River Source- unknown, however it is assumed that RCD effective volume would be used in this scenario.

Based on flows outlined in Chapter 5.2, and assuming all discussed WWTPs are available as a source of recycled water for an AWRP and that the dam is at full capacity, the following discharges would occur:

- 6.5 ML (South and East Lismore to RCD) into 1400 ML reservoir is 0.5% by volume in any 24-hr period
- 6.05 ML (all surrounding WWTP to ECD) into 750 ML is 0.8 % by volume in any 24 hr period.

To calculate hydraulic detention, several factors must be considered, including:

- Environmental inflows and outflows the dam
- Evaporation
- Dam effective volume, including varying dam levels
- Variable water take-off for treatment

5.3.1.2 Waste Water Disposal

AWRPs, particularly where RO is employed, typically produce a concentrated wastewater stream. Mainstream methods of wastewater disposal include:

- Evaporation ponds
- Surface water discharge
- Sewerage discharge
- Land application and soil infiltration

- Deep well injection
- Ocean outfall

The method of waste disposal for an AWRP is dependent on the treatment process at the AWRP, water quality of the source water for the AWRP and discharged water quality and flow targets. Surface water and sewerage discharge are the lowest cost options given they usually require minimal capital upgrades and can use existing infrastructure. However, approval from EPA for these methods of disposal is likely to be more onerous when compared to other methods such as ocean outfall.

Evaporation ponds have high capital costs, due to their large footprint and may be difficult to implement in the region due to the climate. The area has a hot, humid summer and mild winter, which means that evaporation rates are low compared to other areas in Australia.

Indicative costs for these options varies significantly, as summarised in Table 5-2.

Table 5-2: Summary of Indicative Costs for Various Wastewater Disposal Methods

Disposal	Cost per m^3 of Brine Discharge [a]
Surface water discharge [b]	US $0.05-0.3/m^3
Sewer discharge	US $0.32–0.66/m^3
Deep-well injection	$0.54–2.65/m^3
Evaporation ponds	US $3.28–10.04/m^3
Land application	US$0.74–1.95/m^3

Notes:

- a- adapted from Panagopoulos et al, Desalination brine disposal methods and treatment technologies - A review (2019)
- b - this paper considers surface water discharge and ocean outfall as one kind of disposal method.

Wastewater disposal has not been considered further in this feasibility study. Options should be considered during options development and concept design stages for preferred reuse options.

5.3.2 Direct Non-Potable Reuse

For direct non-potable reuse of recycled water, the AGWR Phase 1 applies. The level of treatment recommended in the guideline is based on the exposure for the intended end use. As with indirect potable reuse, log reduction targets have been developed for three pathogen groups for each main class of end use, summarised in the table below.

Table 5-3 Log Reduction Targets for End Uses

Log Reduction Targets	Bacteria	Protozoa	Viruses	Water Quality Objectives
Dual reticulation, toilet flushing, washing machines, garden use	5	5	6.5	-To be determined on case-by-case basis depending on technologies - Could include turbidity criteria for filtration, disinfectant Ct or dose (UV)

				- E. coli <1 per 100 mL
Municipal use - open spaces, sports grounds, golf courses, dust suppression, or unrestricted access and application	4	3.5	5	-To be determined on case-by-case basis depending on technologies - Could include turbidity criteria for filtration, disinfectant Ct or dose (UV) -E. coli <1 per 100 mL

The AGWR Phase 1 also provides indicative log removals of enteric pathogens and indicator organisms for different treatment processes. Based on these log reductions and the targets in the table above, the end use targets are met (LRV surplus), or there is an LRV deficit, indicating additional or more optimised treatment is required.

The tables below summarise the treatment LRVs and if this treatment meets the treatment requirements for the end uses. Each table shows:

- The minimum and maximum LRV achievable by the current treatment process using guideline values published in AGWR Phase 1.
- The LRV deficit or surplus for each end use. This is calculated based on the LRV targets outlined in Table 5-3 and the treatment LRV achievable.
  - Green indicates the treatment exceeds the LRV requirements
  - Grey indicates the treatment meets the LRV requirements
  - Red indicates the treatment does not meet the LRV requirements. Additional validation or treatment is required.

The log reductions achievable for each WWTP will likely fall within the range provided, the treatment processes should be validated by published data or direct testing.

Table 5-4 Ballina WWTP LRV Summary

Description		Bacteria		Protozoa		Virus	
		Min	Max	Min	Max	Min	Max
Treatment LRVs achievable	Primary Treatment Secondary Treatment Membrane Filtration UV Disinfection Chlorination	8.5	19.5	9.5	13	5	14.1
End use surplus or deficit	Dual Reticulation	3.5	14.5	4.5	8	-1.5	7.6
	Municipal Use	4.5	15.5	6	9.5	0	9.1

Table 5-5 Lennox WWTP LRV Summary

Description		Bacteria		Protozoa		Virus	
		Min	Max	Min	Max	Min	Max
Treatment LRVs achievable	Primary Treatment Secondary Treatment Membrane Filtration UV Disinfection	6.5	13.5	9.5	11.5	4	11.10

End use surplus or deficit	Dual Reticulation	1.5	8.5	4.5	6.5	-2.5	4.6
	Municipal Use (unrestricted)	2.5	9.5	6	8	-1	6.1

Table 5-6 Alstonville WWTP LRV Summary

	Description	Bacteria		Protozoa		Virus	
		Min	Max	Min	Max	Min	Max
Treatment LRVs achievable	Primary Treatment Secondary Treatment UV Disinfection Chlorination	5.00	13.50	3.50	7.00	2.50	8.10
End use surplus or deficit	Dual Reticulation	0	8.5	-1.5	2	-4	1.6
	Municipal Use (unrestricted)	1	9.5	0	3.5	-2.5	3.1

Table 5-7 Bangalow WWTP LRV Summary

	Description	Bacteria		Protozoa		Virus	
		Min	Max	Min	Max	Min	Max
Treatment LRVs achievable	Primary Treatment Secondary Treatment Membrane Filtration UV Disinfection	6.50	13.50	9.50	11.50	4.00	11.10
End use surplus or deficit	Dual Reticulation	1.5	8.5	4.5	6.5	-2.5	4.6
	Municipal Use (unrestricted)	2.5	9.5	6	8	-1	6.1

Table 5-8 South Lismore WWTP LRV Summary

	Description	Bacteria		Protozoa		Virus	
		Min	Max	Min	Max	Min	Max
Treatment LRVs achievable	Primary Treatment Secondary Treatment Cloth Filtration UV Disinfection	3.0	8.5	5.0	8.0	2.0	8.10
End use surplus or deficit	Dual Reticulation	-2	3.5	0.5	3.5	-4	2.1
	Municipal Use (unrestricted)	-1	4.5	1.5	4.5	-3	3.1

Table 5-9 East Lismore WWTP LRV Summary

	Description	Bacteria		Protozoa		Virus	
		Min	Max	Min	Max	Min	Max
Treatment LRVs achievable	Primary Treatment Secondary Treatment Lagoon Storage	3.0	8.5	5.0	8.0	2.0	8.10

End use surplus or deficit	Dual Reticulation	-3	3.5	-3.5	1.5	-5	-0.4
	Municipal Use (unrestricted)	-2	4.5	-2	3	-3.5	1.1

As seen in the tables above, the Ballina and Byron WWTPs generally exceed the LRV requirements for bacteria and protozoa but fall short of virus LRV targets when the minimum LRV value is taken. This is due their high infectivity compared to bacteria and higher disease burden compared to protozoa.

The Lismore WWTPs have greater deficits, indicating additional treatment processes would be required at each of these plants to enable any form of direct non-potable re-use.

With validation above the minimum LRV for the treatment processes in the WWTPs BSC and BySC , these WWTPs are able to meet or exceed the LRV targets for both municipal use and dual reticulation end uses. This would likely not require capital upgrades for treatment, but may require optimisation of the WWTPs, particularly where EPA licence conditions are being exceeded (See section 2). Treatment processes may also require external validation and additional monitoring and maintenance.

As RCC does not have control over treatment processes and water quality output, there is an inherent risk in using this effluent for reuse. In order to mitigate this risk, an agreement should be entered into with constituent councils that are providing RCC with effluent. Notification protocols should be established to notify RCC of any breaches or changes to source water and access to SCADA to monitor water quality and trends could ideally be provided where possible.

The design of an AWRP should establish worst case water quality scenarios and have treatment such that the risk is mitigated even in these scenarios. Where multiple sources are combined, the source with poorer water quality should be used to determine the worst case water quality.

6 Options for Potable Water Offsets and Reuse

Layouts of the key RCC water treatment plants and the council wastewater treatment plants considered in the project can be found in Appendix A and Appendix B. An analysis of the general geography dictates that the Emigrant Creek Dam is the closest key potable water source to Ballina WWTP, Lennox Head WWTP, Alstonville WWTP and Bangalow WWTP. The Wilson River Source (which has existing infrastructure to transfer water to Rocky Creek Dam) is the closest key potable water source to South Lismore WWTP and East Lismore WWTP. For this assessment, it has been assumed the Wilson River Source infrastructure can transfer the required flows from Wilson River to Rocky Creek Dam.

Options for both indirect potable reuse and direct non-potable reuse schemes are outlined in Table 6-2 below. For each indirect potable reuse option, consideration has been given to the following.

1. Treating the effluent at each individual WWTP site and pumping the recycled water to the water source
2. Pumping the effluent to a common AWRP and treating the effluent to required recycled water standard at this location. The common AWRP may be a new stand alone plant or as an upgrade to one of the contributing WWTPs that would accept effluent from multiple sources.

The table below defines the key parameters used in the options summary (Table 6-2).

Table 6-1 Definition of Parameters for Options Summary

Item	Qualifier	Description
Potable Water Saving (ML/d) The amount of potable water that could be saved. This has assumed: ▲ a higher estimated ADWF ▲ Scenario of low recycled water use by Council (where applicable)	Very Low	<0.1
	Low	0.1-0.5
	Medium	0.5-2
	High	2-4
	Very High	4+
Treatment Work Cost ($ million) The cost for possible treatment works including upgrades to existing WWTP and new AWRP. This does not include brine/wastewater disposal. Cost for treatment works is highly variable depend on press/upgrade selection, it is only intended for comparison of options.	Low	< 1
	Medium	1-5
	High	5-10
	Very High	10+
Infrastructure Cost Cost for pipelines required to transport recycled water from Council WWTP to AWRP and end use location (IPR scenarios). Key Assumptions: ▲ Cost estimation is limited to pipe installation only ▲ Cost estimate indicative only ▲ Cost estimation based on NSW Reference Rates Manual, Valuation of water supply, sewerage and stormwater assets, June 2014, NSW ▲ For further details see Appendix C	Low	0-10
	Medium	10-30
	High	30-50
	Very High	50 +

Table 6-2: Summary of Potable Water Offset Options

Option	Description	Schemes	Potable Water Saving	Treatment Works Cost	Infrastructure Cost	Pass/Fail	Comment
Indirect potable reuse to Emigrant Creek Dam	Treat in a common AWRP and Pump Treated Effluent to Emigrant Creek Dam	1. Ballina and Lennox Head WWTPs	Very High	Very High	High	Pass	▲ High potential effluent yield ▲ High potable water offset potential ▲ Concentrate saline waste stream must be disposed of by expensive evaporation or crystallisation techniques
		2. Ballina, Lennox Head and Alstonville WWTPs	Very High	Very High	Very High	Fail	▲ Minimal additional benefit beyond the Ballina/Lennox option (see above) for higher infrastructure costs due to lower effluent yields at Alstonville ▲ Concentrate saline waste stream must be disposed of by expensive evaporation or crystallisation techniques
		3. Ballina, Lennox Head, Alstonville and Bangalow WWTPs	Very High	Very High	Very High	Fail	▲ Minimal additional benefit beyond the Ballina/Lennox option (see above) for higher infrastructure costs due to lower effluent yields at Alstonville and Bangalow ▲ Concentrate saline waste stream must be disposed of by expensive evaporation or crystallisation techniques
	Individual AWRP upgrades at existing WWTPs then pump recycled water to	1. Ballina WWTP	High	High	Medium	Pass	▲ High available effluent ▲ Option may be cost efficient relative to having a common AWRP once the additional cost of treating and disposing of waste stream is considered

Option	Description	Schemes	Potable Water Saving	Treatment Works Cost	Infrastructure Cost	Pass/Fail	Comment
	Emigrant Creek Dam.	2. Lennox Head WWTP	Medium	Medium	Medium	Pass	▲ High available effluent ▲ Option may be cost efficient relative to having a common AWTP once the additional cost of treating and disposing of waste stream is considered ▲ Ocean outfall for saline waste stream from reverse osmosis means EPA approvals are more likely than other creek or estuarine outlets
		3. Alstonville WWTP	Low	Medium	Medium	Fail	▲ Moderate available effluent ▲ Concentrate saline waste stream must be disposed of by expensive evaporation or crystallisation techniques ▲ Low IPR potential due to low yields
		4. Bangalow WWTP	Low	Medium	Medium	Fail	▲ Low available effluent ▲ Concentrate saline waste stream must be disposed of by expensive evaporation or crystallisation techniques ▲ Low IPR potential due to low yields
Indirect potable reuse to Wilson River Source (ultimately Rocky Creek Dam)	Treat in a common AWRP and Pump Treated Effluent to Wilson River Source.	1. South Lismore and East Lismore WWTPs	Very High	Very High	Medium	Pass	▲ High potential effluent yield ▲ Good potable water offset potential ▲ Concentrate saline waste stream must be disposed of by expensive evaporation or crystallisation techniques ▲ Further investigation required

Option	Description	Schemes	Potable Water Saving	Treatment Works Cost	Infrastructure Cost	Pass/Fail	Comment
	Individual AWRP upgrades at existing WWTPs then pumping recycled water to Wilson River Source	1. South Lismore WWTP	Medium	High	Medium	Fail	▲ Good available effluent ▲ Concentrate saline waste stream must be disposed of by expensive evaporation or crystallisation techniques ▲ Further investigation required
		2. East Lismore WWTP	High	High	Medium	Pass	▲ Good available effluent ▲ Concentrate saline waste stream must be disposed of by expensive evaporation or crystallisation techniques ▲ Further investigation required
Direct non- potable reuse schemes	Individual treatment plant upgrades at WWTPs then direct supply to non-potable reuse pipework.	Ballina WWTP	High	Low	High	Pass	▲ Some offset capability, but potable offset less than IPR due to demand generation from recycled water. ▲ BSC has existing 80% reuse target but appears to be geared towards increased non-potable demands.
		Lennox Head WWTP	Medium	Low - Medium	High	Pass	▲ Some offset capability, but potable offset less than IPR due to demand generation from recycled water. ▲ BSC has existing 80% reuse target but appears to be geared towards increased non-potable demands.
		Alstonville WWTP	Low	Medium	High	Fail	▲ Existing scheme is currently highly utilised – non-potable scheme appears to have little extra capacity for meaningful offset
		Bangalow WWTP	Low	Low- Medium	High	Fail	▲ Lack of water available for meaningful offset

Option	Description	Schemes	Potable Water Saving	Treatment Works Cost	Infrastructure Cost	Pass/Fail	Comment
		South Lismore WWTP	Medium	Medium - High	High	Pass	▲ There is not any known existing recycled water scheme ▲ More data required to undertake meaningful analysis
		East Lismore WWTP	High	Medium-High	High	Pass	▲ There is not any known existing recycled water scheme ▲ More data required to undertake meaningful analysis

IPR is recommended as the most effective potable water offset measure rather than direct non-potable reuse. IPR has advantages over non-potable reuse because it utilises the existing potable water supply network, provides a base load water source, directly offsets existing water sources and can be charged at normal potable water rates. Often dual reticulation schemes or open space irrigation schemes, while they partially result in potable water offsets, generate additional water usage which cannot be claimed as a potable water offsets.

The preferred IPR options from the analysis in Table 6-2 is based on combining effluent from multiple sources for treatment at an upgraded WWTPs prior to pumping potable grade recycled water to the water supply source. This would utilise the existing infrastructure and services, minimising capital cost required to provide advanced treatment processes. This also leaves open the option of direct potable reuse in future to further reduce costs without compromising drinking water quality compliance.

6.1 Emigrant Creek Dam

For IPR at the Emigrant Creek Dam water source, the preferred option is to transfer effluent from Ballina WWTP to Lennox Head WWTP where the two effluent sources would be combined. This effluent would be further treated at Lennox Head WWTP by advanced processes prior to transfer to Emigrant Creek Dam. Due to the high influent flows through these two WWTPs and expected moderate IPR yields, of the four WWTPs around Emigrant Creek Dam considered, this arrangement is expected to result in the lowest infrastructure cost for the greatest potable water offset.

The Alstonville WWTP and Bangalow WWTP are not recommended to be part of the scheme as they require additional water transfer infrastructure for little expected additional yield. It should be emphasised that due to BSC's existing commitment to implement non-potable recycled water, any scheme should be developed in conjunction with BSC as the non-potable water reuse scheme will impact on the expected future yield of any IPR scheme.

6.2 Wilson River

For the Wilson River water source, the preferred option is to transfer effluent from East Lismore WWTP to South Lismore WWTP where the two effluent sources would be combined. Combined effluent is recommended to be treated at South Lismore WWTP and the potable recycled water transferred to the Wilson River Source as it is anticipated that the South Lismore WWTP would be a better site for an AWRP from a site infrastructure perspective, compared to the Wilson River site (this needs further confirmation with RCC). Due to the high influent flows through these two WWTPs as outlined in RCCs IWCM, this arrangement is expected to result in good IPR yields.

It is anticipated that the existing infrastructure would be used to transfer treated effluent from the Wilson River source into Rocky Creek Dam, this may require some modification of the pipeline to avoid direct use of the water from the Wilson River source without required detention.

7 Recommendations and Next Steps

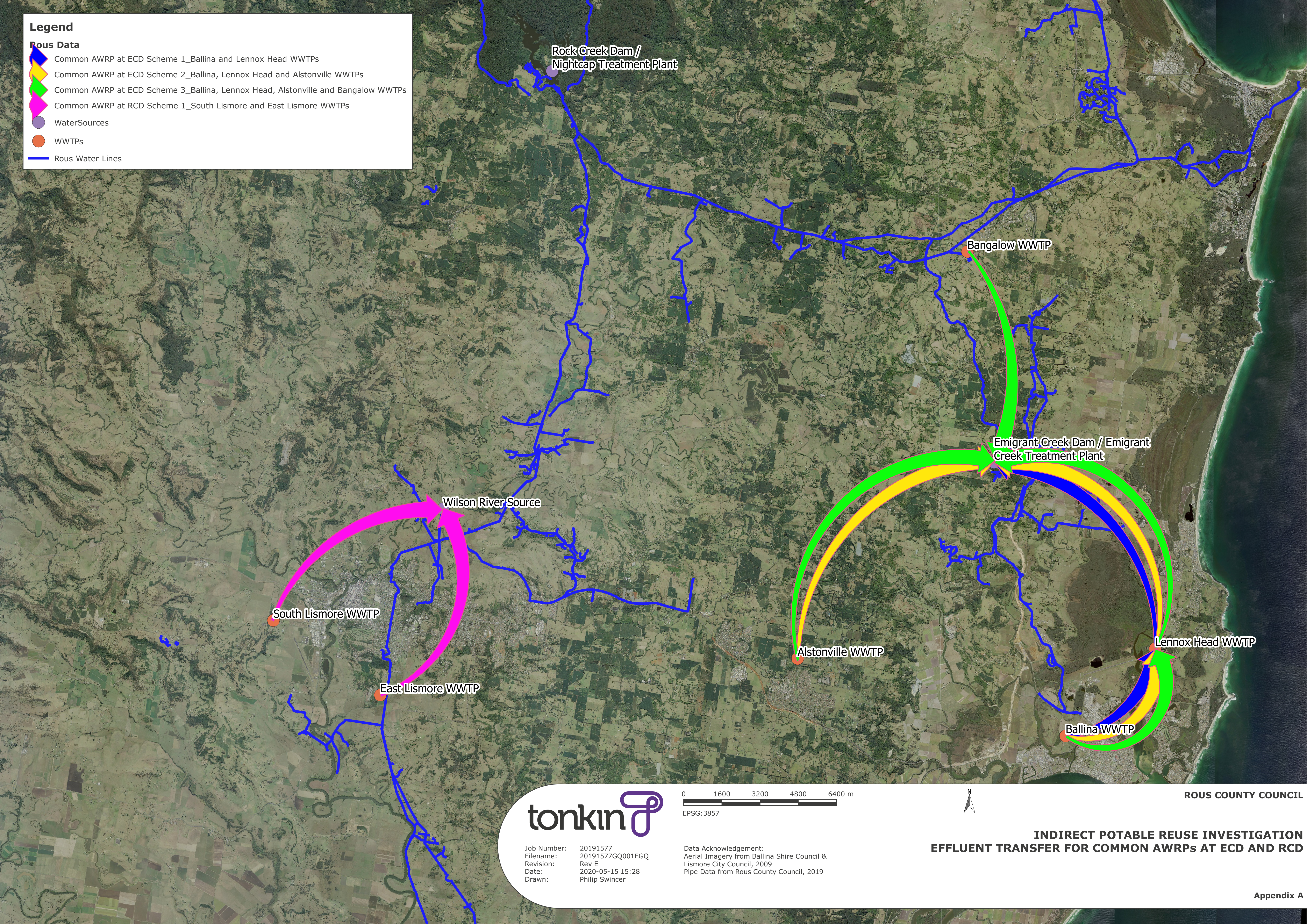
- From this feasibility study, 2 preferred options for water reuse have been identified for further development. These are: IPR scheme utilising effluent from Ballina and Lennox Head WWTPs for discharge into ECD; and
- IPR scheme utilising effluent from South and East Lismore for discharge to Wilson River /RCD

Further development of these options will require liaison with other stakeholders (i.e. constituent councils, NSW Health and DPIE representatives) to understand the likelihood of gaining approval for the proposed schemes, identify possible conditions for supply agreements, and to determine planning requirements for each scheme.

Further technical development of these options should also be undertaken through preparation of a preliminary concept design and associated investigations considering the following:

- Effluent storage sizes and configurations
- Selection of a preferred treatment process for the AWRP
- Sizing and functional requirements of individual unit processes
- Pump station requirements including configuration, potential reuse of existing infrastructure, footprint, flow requirements and components
- Mains requirements including route assessment, size, material and hydraulics
- Wastewater treatment and discharge options
- Hydraulic detention and dilution environmental buffers
- Power requirements
- Identification of land tenure issues (e.g. native title or easement requirements)

Appendix A Effluent Transfer for Common AWRPs at ECD and RCD



Legend
Rous Data
Common AWRP at ECD Scheme 1_Ballina and Lennox Head WWTPs
Common AWRP at ECD Scheme 2_Ballina, Lennox Head and Alstonville WWTPs
Common AWRP at ECD Scheme 3_Ballina, Lennox Head, Alstonville and Bangalow WWTPs
Common AWRP at RCD Scheme 1_South Lismore and East Lismore WWTPs
WaterSources
WWTPs
Rous Water Lines
Rock Creek Dam / Nightcap Treatment Plant
Bangalow WWTP
Emigrant Creek Dam / Emigrant Creek Treatment Plant
Wilson River Source
South Lismore WWTP
East Lismore WWTP
Alstonville WWTP
Lennox Head WWTP
Ballina WWTP
0 1600 3200 4800 6400 m
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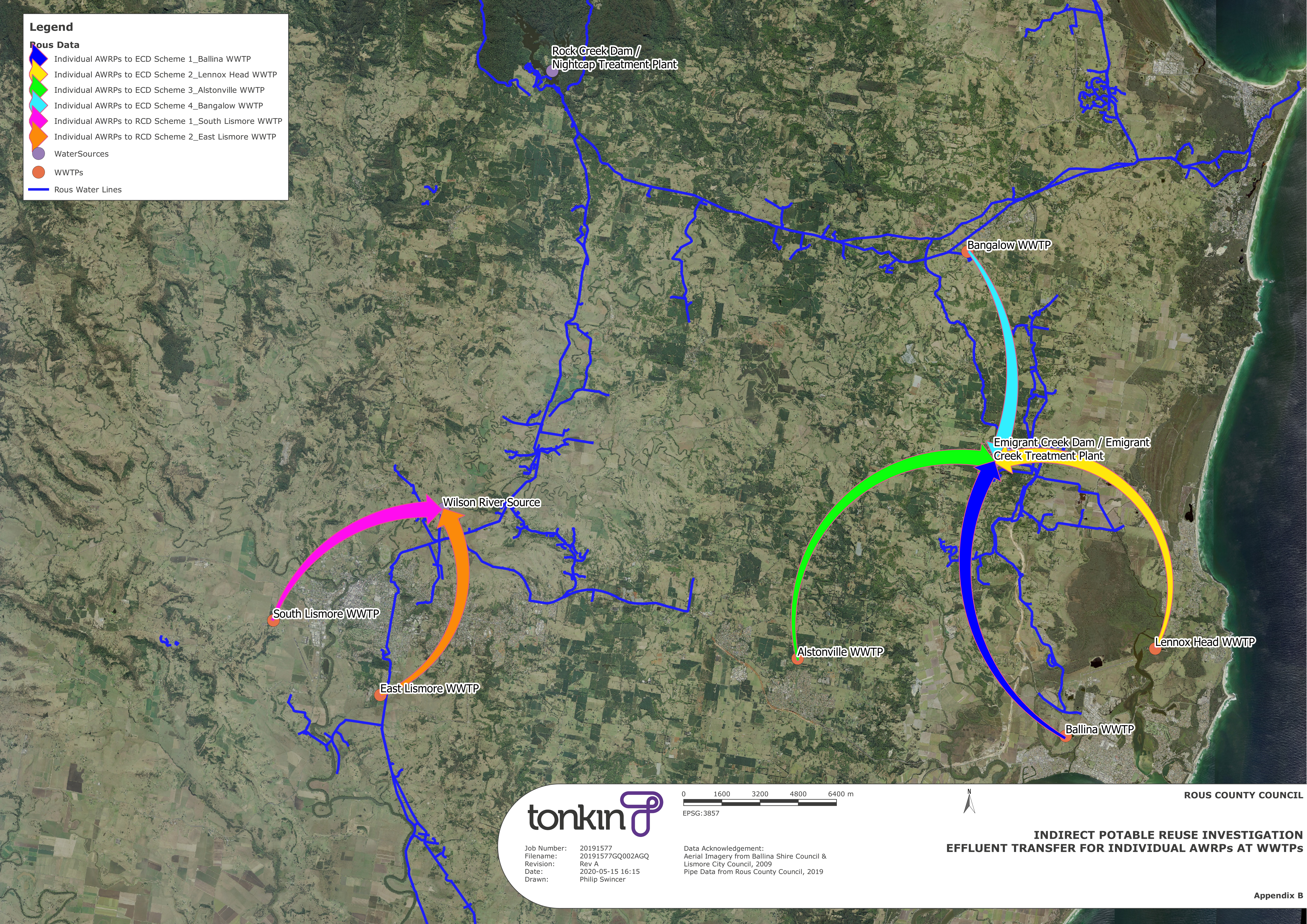
Job Number: 20191577
Filename: 20191577GQ001EGQ
Revision: Rev E
Date: 2020-05-15 15:28
Drawn: Philip Swincer
Data Acknowledgement:
Aerial Imagery from Ballina Shire Council & Lismore City Council, 2009
Pipe Data from Rous County Council, 2019
ROUS COUNTY COUNCIL
INDIRECT POTABLE REUSE INVESTIGATION
EFFLUENT TRANSFER FOR COMMON AWRPs AT ECD AND RCD
Appendix A

Appendix B Effluent Transfer for Common AWRPs at ECD and RCD



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Job Number: 20191577
Filename: 20191577GQ002AGQ
Revision: Rev A
Date: 2020-05-15 16:15
Drawn: Philip Swincer

Data Acknowledgement:
Aerial Imagery from Ballina Shire Council & Lismore City Council, 2009
Pipe Data from Rous County Council, 2019

ROUS COUNTY COUNCIL

INDIRECT POTABLE REUSE INVESTIGATION
EFFLUENT TRANSFER FOR INDIVIDUAL AWRPs AT WWTPs

Appendix B

Appendix C Cost Estimation

Option	Option Breakdown	Cost (2020 $ millions)
Pump Treated Effluent to Emigrant Creek Dam and treat in a common AWRP.	Ballina and Lennox Head WWTPs	38.8
	Ballina, Lennox Head and Alstonville WWTPs	56.0
	Ballina, Lennox Head, Alstonville and Bangalow WWTPs	67.5
Individual AWRP upgrades at existing WWTPs then pump recycled water to Emigrant Creek Dam.	Ballina WWTP	22.9
	Lennox Head WWTP	21.4
	Alstonville WWTP	17.2
	Bangalow WWTP	11.5
Pump Treated Effluent to Wilson River Source at treat in a common AWRP.	South Lismore and East Lismore WWTPs	28.8
Individual AWRP upgrades at existing WWTPs then pumping recycled water to Wilson River Source	South Lismore WWTP	14.1
	East Lismore WWTP	14.7

Key Assumptions

- Cost estimation is limited to pipe installation only
- Cost estimation based on NSW Reference Rates Manual, Valuation of water supply, sewerage and stormwater assets, June 2014, NSW DPI
- Estimated length based on general road alignments, with 20% length contingency
- Pipe capacity based on conservative estimate of peak day flow
- Pipe assumed to be MSCL with minimum plate thickness
- Assumed typical costs include survey, investigation, design, project management and construction costs
- Allowance made for encountering small amounts of ground water and rock along alignment
- Allowance made for moderate construction difficulty

- As per manual, rates allow for pipe supply, excavate, lay, backfill, restoration, fittings, thrust blocks, air valves, scour valves and isolating valves
- As per manual, rates assume excavation is OTR and pipelines are laid to minimum depth
- Allowance does not account for contingencies, GST, special crossings and local site constraints
- 2014 prices have been adjusted to 2020 prices based on building price indices presented in Rawlinsons Construction Handbook 2020